

# The Palaeolithic in Southern China



JOHN W. OLSEN AND SARI MILLER-ANTONIO

THE INTERPRETIVE FRAMEWORK that currently dominates Palaeolithic archaeology in China has derived mainly from the study of Palaeolithic assemblages in northern China. In the past twenty years, however, many new Palaeolithic sites have been discovered in southern China that document the antiquity of human occupation in that region. Rich cultural and faunal inventories in association with early human remains bear important implications for understanding Southeast Asian prehistory and hominid evolution.

This paper details the archaeological and human fossil materials recovered from 17 localities throughout southern China. We discuss the geological context and chronology for each locality. Our coverage includes a broad temporal range from the Lower and Middle Pleistocene *Homo erectus* sites of Longgupo (Wushan), Yuanmou, and Longtandong (Hexian) through the critical "transitional" stage from *H. erectus* to early *Homo sapiens* represented by remains from Yanhuidong (Tongzi) and Maba. We include a discussion of the lithic inventories from Upper Pleistocene localities in Guizhou, Yunnan, Sichuan, and Fujian that add a new dimension to the variability within the Southern Chinese Palaeolithic.

## EXISTING SCHOLARSHIP IN SOUTH CHINESE PLEISTOCENE ARCHAEOLOGY

The difficulties of pursuing research on the Pleistocene prehistory of South China are compounded by the fact that until recently, very few archaeological reports from that region found their way into English or other Western-language literature. Those unable to read Chinese are still at a distinct disadvantage as far as gaining access to primary documentation is concerned (a fact amply demonstrated by this paper's bibliography), but several broad-ranging publications exist in English (e.g., Aigner 1981; K. C. Chang 1986; Ikawa-Smith 1978; R. O. Whyte 1984; P. Whyte et al. 1988; Wu and Olsen 1985) that constitute a good starting point for subsequent research. The Chinese journals *Kaogu Xuebao* (*Acta Archaeologica Sinica*) and *Renleixue Xuebao* (*Acta Anthropologica Sinica*), both published in Beijing, contain English abstracts of main articles. Other Chinese journals such as *Kaogu* (*Archaeology*), *Wenwu* (*Cultural Relics*), *Nanfang Minzu Kaogu* (*Southern Ethnology and Archaeology*), and *Shiqian Yanjiu* (*Prehistoric Studies*) often provide a table of contents, but little else, in English. Most of the provincial museums and antiquities authorities of South

John W. Olsen is an associate professor and Sari Miller-Antonio recently completed her Ph.D. in the Department of Anthropology, University of Arizona, Tucson, AZ.

*Asian Perspectives*, Vol. 31, no. 2. © 1992 by University of Hawaii Press. All rights reserved.

China issue their own in-house publication series, but these are generally published only in Chinese and are difficult to gain access to outside of China.

In Taiwan, the Academia Sinica sponsors a series entitled *Lishi Yuyan Yanjiusuo Jikan* that publishes articles in both English and Chinese, as does National Taiwan University's *Kaogu Renleixue Kan*.

Two exclusively Chinese-language publications that must be considered critical references are the encyclopedic works of Xie and You (1984) and Wu Rukang et al. (1989). The South Chinese Palaeolithic is also increasingly documented by monograph-length reports on particular sites such as Yuanmou, Yunnan (Zhou and Zhang 1984), and Guanyindong, Guizhou (Li Yanxian and Wen 1986). Li Yanxian (1982) and Zhang Senshui (1983) provide useful overviews and thorough bibliographies, current to the early 1980s.

#### TEMPORAL CONSIDERATIONS

We employ geochronological terms (Lower, Middle, and Upper Pleistocene) for the categorization of archaeological and human paleontological assemblages in South China to avoid the problematical use of European-derived concepts such as Early, Middle, and Late Palaeolithic (Table 1). In the decades that have passed since Hallam Movius's (1944, 1949) pioneering attempts to arrive at a large-scale synthesis of East Asian prehistory, it has become increasingly apparent that the application of traditional Palaeolithic subdivisions in China may be misleading (Clark and Yi 1983; Pope 1988, 1989; Watanabe 1985). For example, we feel there is little to be gained by simply labeling every early Upper Pleistocene industry in China "Middle Palaeolithic," because in most cases there is no technological congruence between industries of this age in China and the Western Old World to warrant such a blanket inclusion. This is especially true in South China where relatively few earlier Pleistocene (e.g., before ca. 125,000 B.P.) industries are associated in any unambiguous way with hominid fossils.

We consider the Lower Pleistocene to include the period from roughly two million years ago to the Matuyama [R] chron/Brunhes [N] chron palaeomagnetic boundary at ca. 730,000 years B.P. The Middle Pleistocene in China is defined as that period from the beginning of the Brunhes epoch to the Oxygen Isotope Stage 5–Stage 6 boundary at  $128,000 \pm 3000$  years. Finally, the Upper Pleistocene includes the most recent glacial cycle of the Ice Age from roughly 128,000 to 10,000 years B.P. (Oxygen Isotope Stages 5–2).

The past 20 years have witnessed an explosion of archaeological activity in China, both as a consequence of China's increasingly frequent interaction with scientific communities abroad and of the domestic fostering of public interest in China's past (Wu Rukang and Shenglong 1985; Olsen 1987). One result of this active program of archaeological investigation has been the discovery of a large number of new localities in South China that bear important implications for our understanding of greater Southeast Asian prehistory. For the purposes of this paper, we have chosen to describe in detail a range of localities that have yielded the most important of South China's Pleistocene remains in terms of the nature and abundance of excavated materials as well as the existence of substantial primary documentation. However, references to a large number of additional sites, thorough descriptions

TABLE 1. PLEISTOCENE HOMINID FOSSIL LOCALITIES AND ARCHAEOLOGICAL SITES OF SOUTH CHINA

PROVINCE OR AUTONOMOUS REGION	SITE NAME <sup>a</sup>	DISTRICT AND/OR COUNTY NAME	AGE	HUMAN FOSSILS	ARTIFACTS
Anhui	Longtandong	Hexian	Middle Pleistocene	+	+
	Yinshan	Chaoxian	Middle Pleistocene	+	
Jiangsu	Xiacaowan	Sihong	Upper Pleistocene	+	
	Lianhuadong	Dantu	Upper Pleistocene	+	
	Sanshandao	Taihu	Upper Pleistocene		+
	Gaozi	Dantu	Upper Pleistocene	+	
	Miaojiashan	Jurong	Upper Pleistocene		+
	Daxianzhuang	Donghai	Upper Pleistocene		+
	Linggudong	Yixing	Upper Pleistocene	+	
	Qinglongshan	Jintan	Upper Pleistocene		+
	Taohuajian	Lianyungang	Upper Pleistocene		+
Zhejiang	Wuguidong	Jiande	Upper Pleistocene	+	
Jiangxi	Yongshandong	Leping	Upper Pleistocene		+
Hubei	Longgudong	Yunxian	Lower-Middle Pleistocene	+	+
	Bailongdong	Yunxi	Middle Pleistocene	+	+
	Shilongtou	Dazhi	Middle Pleistocene		+
	Shanwan	Xiangyang	Upper Pleistocene		+
	Jiufengshan	Wuhan	Upper Pleistocene		+
	Xiazhongjiawan	Changyang	Middle-Upper Pleistocene		+
	Guojiuyan	Changyang	Middle-Upper Pleistocene	+	
	Longdong	Changyang	Middle-Upper Pleistocene	+	
	Tuziwa	Fangxian	Upper Pleistocene		+
	Suixian	Suixian	Upper Pleistocene		+
Hunan	Yanqiudong	Guiyang	Upper Pleistocene	+	
	Bosulincun	Xinwang Xinglong	Upper Pleistocene	+	
Guangdong	Shizishan	Maba	Upper Pleistocene	+	+
	He'erkou	Fengkai	Upper Pleistocene	+	
Guangxi Zhuang	Bailiandong	Liuzhou	Upper Pleistocene		+
	Tongtianyan	Liujian	Upper Pleistocene	+	+
	Baojiyan	Guilin	Upper Pleistocene	+	+

(continues)

TABLE 1. (continued)

PROVINCE OR AUTONOMOUS REGION	SITE NAME <sup>a</sup>	DISTRICT AND/OR COUNTY NAME	AGE	HUMAN FOSSILS	ARTIFACTS
Yunnan	Qilinshan	Laibin	Upper Pleistocene	+	+
	De'e	Longlin	Upper Pleistocene	+	
	Jiulinshan	Du'an	Upper Pleistocene	+	+
	Hongkudong	Linshan	Upper Pleistocene	+	
	Dingmodong	Tiandong	Upper Pleistocene	+	
	Shangsongcun	Bose	Middle–Upper Pleistocene		+
	Xinzhou	Bose	Middle–Upper Pleistocene		+
	Gaitoudong	Laibin	Upper Pleistocene	+	+
	Siduoyan	Liuzhou	Upper Pleistocene		+
	Douleyan	Liuzhou	Upper Pleistocene	+	
	Chenjiayan	Liujiang	Upper Pleistocene		+
	Dongyandong	Guilin	Upper Pleistocene		+
	Shuiyandongdong	Lipu	Upper Pleistocene	+	
	Aidong	Chongzuo	Upper Pleistocene		+
	Jiulengshan	Du'an	Upper Pleistocene	+	
	Ganyanyandong	Du'an	Upper Pleistocene	+	
	Shangnabang	Yuanmou	Lower Pleistocene	+	+
	Sijiacun	Yuanmou	Lower–Middle Pleistocene	+	+
	Xiaqiliu	Yuanmou	Lower–Middle Pleistocene	+	+
	Xincun	Yuanmou	Lower–Middle Pleistocene	+	+
	Danengyucun	Yuanmou	Lower–Middle Pleistocene	+	+
	Laoyatang	Yuanmou	Lower–Middle Pleistocene	+	+
	Baishiling	Lu'nan	Upper Pleistocene		+
	Xianrendong	Xichou	Upper Pleistocene	+	
	Mujiaqiao	Lijiang	Upper Pleistocene	+	+
	Longtanshan	Chenggong	Upper Pleistocene	+	+
	Qiaotou	Hekou	Upper Pleistocene		+
	Gongjishan	Zhaotong Tangfang	Upper Pleistocene	+	
	Jiulongkoudong	Maguan	Upper Pleistocene		+
	Banqiaojie	Lu'nan	Upper Pleistocene		+
Guizhou	Guanyindong	Qianxi	Middle–Upper Pleistocene		+
	Yanhuidong	Tongzi	Upper Pleistocene	+	+

	Ma'anshan	Tongzi	Upper Pleistocene	+	+
	Chuandong	Puding	Upper Pleistocene	+	+
	Baiyanjiaodong	Puding	Upper Pleistocene		+
	Shuangshan	Puding	Upper Pleistocene		+
	Wangjiayuanzi	Weining	Upper Pleistocene		+
	Taohuadong	Liuzhi	Upper Pleistocene	+	+
	Maomaodong	Xingyi	Upper Pleistocene	+	+
	Feihushan	Pingba	Upper Pleistocene		+
	Laoyadong	Huajie	Upper Pleistocene		+
	Xiaohuidong	Yongcheng	Upper Pleistocene	+	+
Sichuan	Longgupo	Wushan	Lower–Middle Pleistocene	+	+
	Huangshanxi	Ziyang	Upper Pleistocene	+	+
	Liyuqiao	Ziyang	Upper Pleistocene		+
	Shixiazi	Ziyang	Upper Pleistocene		+
	Shaju	Ziyang	Upper Pleistocene		+
	Fulin	Hanyuan	Upper Pleistocene		+
	Zhang'ertang	Tongliang	Upper Pleistocene		+
Fujian	Lianhuachishan	Zhangzhou	Upper Pleistocene		+
	Zhulinshan	Zhangzhou	Upper Pleistocene		+
	Dongshan	Zhangzhou	Upper Pleistocene	+	
	Zhangzhoushi Beijiao	Zhangzhou	Upper Pleistocene	+	
Taiwan	Baxiandong	Taidong Changbin	Upper Pleistocene		+
	Cailiaoxi	Tainan Zuozhen	Upper Pleistocene	+	

Modified after Wu Rukang et al. 1989: 406–408 and Xie and You 1984: 163–165.

<sup>a</sup>In site names, the final syllables “dong” and “yan” may generally be translated as “cave” and “rockshelter.” Thus, Longtandong or Longtan Cave; Tongtianyan or Tongtian Rockshelter. Many Chinese localities are glossed under their county names. Thus, Longtandong in Anhui province is often referred to as the Hexian locality; Shangnabang in Yunnan is known simply as Yuanmou, etc.

of which are omitted here because of constraints of space, may be found in Table 1 and in the bibliography.

#### THE QUATERNARY PALAEOENVIRONMENT AND PALAEOLITHIC SITES OF SOUTH CHINA

The vast Chinese landmass, after the close of the Mesozoic and until the early Tertiary, was a monotonous undulating topography of peneplains reflecting a tectonically stable environment (Liu and Ding 1984a; Wang Xianzheng 1984; Xu Ren 1984). This quiet period came to an end by the late Tertiary with the forceful Himalayan Tectonic Orogeny, resulting in the extinction of the Asian Tethys Sea and the uplift of the Tibetan Plateau and surrounding areas (Zhao 1988).

As the Tibetan Plateau rose to an average elevation of 3000 m by the early Pleistocene, China's relatively homogeneous warm Tertiary climate differentiated and the monsoon climate of East Asia with cold, dry winters and warm, moist summers became established. By 10,000–12,000 years ago, the formidable Tibetan Plateau, with an area of 2.5 million sq km, had attained its present mean elevation of 4000 m and the contemporary complex physical regionalization of China had been developed (Zhao 1988).

The archaeological and human palaeontological remains to be discussed in this paper are located south of 33°N latitude and east of the eastern margin of the Tibetan Plateau (Fig. 1), coinciding roughly with the 3000-m contour line. This broad geographical region today encompasses both subtropical and tropical humid ecological zones and includes the modern administrative districts of southern Jiangsu, southern Anhui, southern Hubei, eastern Sichuan, Yunnan, Guizhou, Hunan, Guangdong, Jiangxi, Fujian, and Zhejiang provinces as well as the Guangxi Zhuang Autonomous Region and the large islands of Hainan and Taiwan.

Extensive land area, mild climatic conditions, and abundant water resources have resulted in profuse and varied species of flora and fauna. The subtropical humid zone is dominated by evergreen broad-leaved forests, and bamboo groves flourish. The tropical humid zone is predominantly monsoon deciduous forest and the faunal suite includes a complicated array of many endemic species. Arboreal and fruit-eating species of vertebrates are abundant as are many species of primates. Coral is the extensive marine fauna in the South China Sea, thriving today in water temperatures of 25–30°C (Zhao 1986:123–156).

A study of sea level changes along the coast of the South China Sea since the late Pleistocene indicates a period of marine transgression between 38,000 and 18,000 years B.P. At about 15,000 years B.P., a lowering of sea level resulted in the creation of a land bridge between Mainland South China and the islands of Taiwan and Hainan that allowed the terrestrial migration of fauna from the continent to what are now isolated offshore niches (Huang Yukun and Chen 1988). The sea level subsequently rose rapidly to its present condition in the postglacial period from 11,000 to 7000 years B.P.

There is a good deal of controversy concerning when the monsoon system had become strong enough to cause a reorganization of climatic zones (Wang Pinxian 1988). Palynological studies from Yunnan Province suggest only minor differences between the climate during the last glacial maximum (ca. 18,000–22,000 B.P.) and the present climatic regime. These data indicate slightly different polar frontal posi-

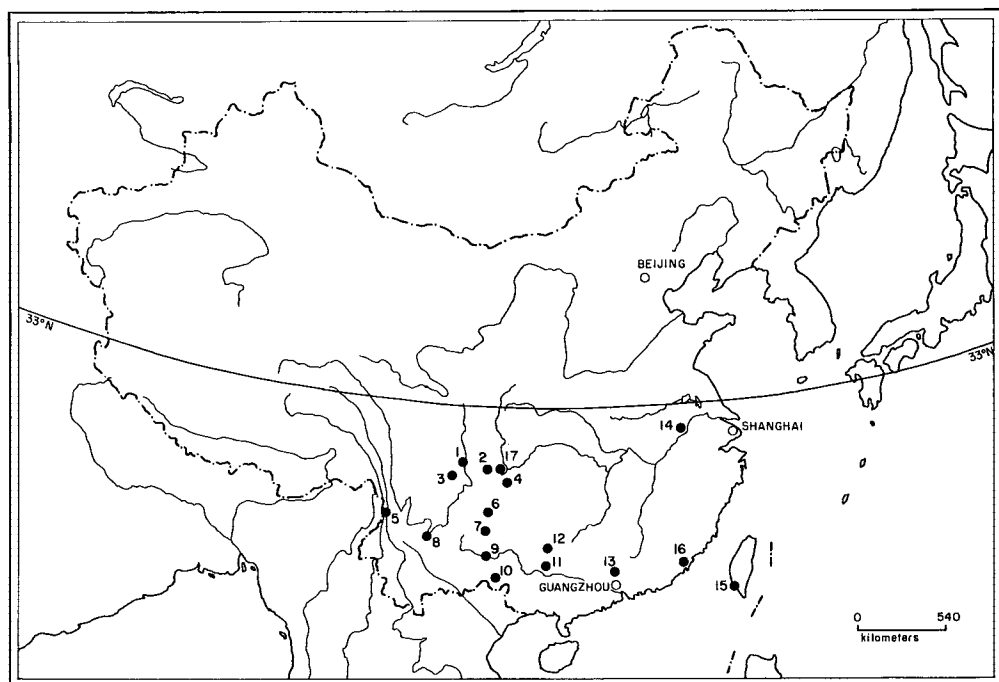


Fig. 1. Map of the People's Republic of China indicating South Chinese localities discussed in the text: 1, Ziyang, Sichuan; 2, Tongliang, Sichuan; 3, Fulin, Sichuan; 4, Yanhuidong, Guizhou; 5, Mujiaqiao, Yunnan; 6, Guanyindong, Guizhou; 7, Baiyanjiao, Guizhou; 8, Yuanmou Basin, Yunnan; 9, Maomaodong, Guizhou; 10, Bose (Baise) Basin, Guangxi; 11, Tongtianyan, Guangxi; 12, Baojiyan, Guangxi; 13, Shizishan, Guangdong; 14, Longtandong, Anhui; 15, Cailiaoxi, Taiwan; 16, Zhangzhou, Fujian; 17, Wushan, Sichuan.

tions and steeper temperature gradients as a result of the greater temperature differences between land and sea (Walker and Sun 1988).

Ancient South Chinese soils, characterized by red earths and laterites, were formed at various times throughout the Quaternary and have been used to document climatic fluctuations (Zhu 1988). They support the implication that the tropical climatic zones have moved south since the late Tertiary. This palaeoclimatic model is further supported by the recovery of *Stegodon* (an extinct elephant-like form) remains from North China. These index fossils of the "southern" Chinese *Stegodon-Ailuropoda* faunal assemblage suggest that some species enjoyed a more extensive zoogeographic distribution earlier in the Quaternary (Aigner 1981; Han and Xu 1989:358–360). This wider temporal and spatial distribution of some species must be taken into account when archaeological remains are dated on the basis of associated fauna.

#### *Yuanmou Basin, Yunnan*

The Yuanmou Basin, located in the eponymous county in northern Yunnan Province at an elevation of slightly more than 1000 m, has long been known for its rich assemblages of Quaternary vertebrate fossils. In 1965, researchers from the Chinese

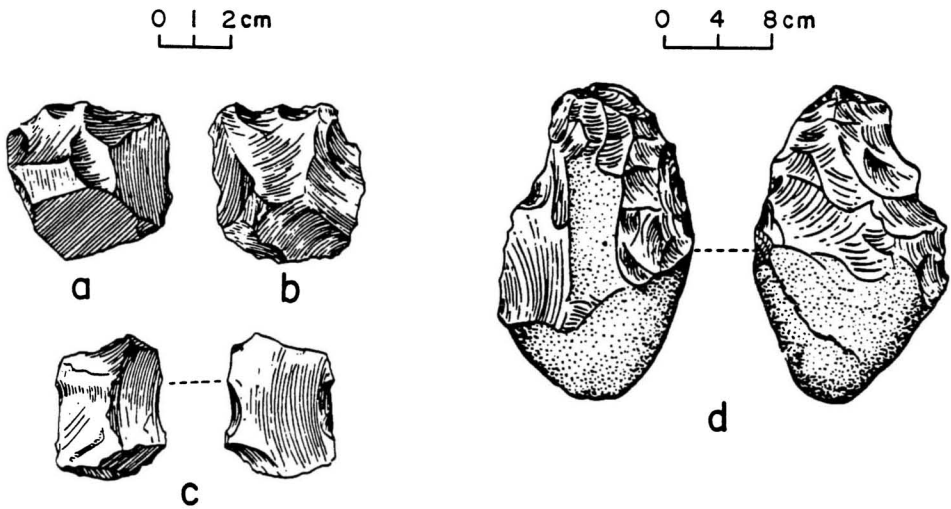


Fig. 2. *a-c*, thick quartzite scrapers from the early Pleistocene deposits at Shangnabang, Yuanmou Basin, Yunnan (after Wen 1984). *d*, large bifacially flaked cobble from the Bose Basin, Guangxi (after Huang Weiwen 1987).

Academy of Geological Sciences discovered, in the vicinity of Shangnabang village, two human teeth (left and right upper central incisors) that have been classified as *Homo erectus* (Hu 1973). In addition, the sedimentary Yuanmou Basin (formerly known as Makai Valley) has yielded a small number of chipped stone tools, both from surface and buried contexts (Fig. 2*a-c*), that have led some to conclude that these questionably associated fossils and artifacts are evidence of some of China's earliest occupants (Jia 1985:141; Zhou and Zhang 1984). The Yuanmou Formation consists of an almost 700-m-thick sequence of fluvio-lacustrine strata subdivisible into four main members and 28 distinct layers (Zhou and Zhang 1984:76-77). Member 4, the uppermost member in the formation, is of particular interest because it was in brownish clay sediments, near the bottom of Layer 25, that the first remains of *Homo erectus*, the two incisors described above, are thought to have been recovered (the fossils' specific find-spot has been reconstructed from eye-witness accounts because the specimens were apparently not collected under controlled conditions).

These teeth, thought to be those of a single individual, perhaps a young adult male, were ascribed to a new subspecies, *H. erectus yuanmouensis*, because Hu (1973) believes they differ in some important respects (overall proportions and the morphology of the lingual surfaces) from the well-known North Chinese Middle Pleistocene hominid, *H. erectus pekinensis*. Zhou and Hu (1979) have stressed the primitiveness of the Yuanmou morphological characters and regarded these incisors as indicative of an early stage in the evolutionary development of *Homo erectus*. It has been noted by Wu Rukang and Dong (1985), however, that there is no consensus on the validity of Hu's (1973) assignment of the Yuanmou incisors to a new subspecies and many palaeoanthropologists consider these specimens to belong to the same subspecies as other *Homo erectus* fossils found elsewhere in China.

Excavations at a number of localities in Yuanmou County have yielded scraps of



charcoal, interpreted as the result of intentional hominid activity, and a small number of chipped vein quartz artifacts. Layer 25, the stratum near the bottom of Member 4 in which the original Yuanmou incisors are thought to have been found, also produced three clearly retouched stone implements, variously classified as cores or scrapers (Jia 1985:140). Although none derived from the same horizon as the teeth themselves (two were collected about 50 cm below where the incisors were found and one was collected about 1 m above the dentition), all three specimens were found within a 20-m radius of the fossils. In addition to these implements, three similar pieces were collected from the surface at Shangnabang and are thought on typological grounds to have also been fashioned by *Homo erectus*. Cores, flakes, choppers, pointed tools, and scrapers collected in 1973 at five additional localities (Sijiacun, Xiqiliu, Xincun, Danengyucun, and Laoyatang) within a 15-km radius of Shangnabang are unassociated with hominid remains but are thought, again on the basis of their morphology and technique of manufacture, to be related to the tools originally found at Shangnabang (Wen 1984).

In 1973, large quantities of charcoal, individual pieces ranging up to several grams, were excavated from the bed that contained the Yuanmou incisors. In all, three layers totaling about 3 m in thickness were found to contain charcoal traces. In 1975, two blackened mammalian fossils were recovered at Shangnabang that are thought by some to constitute evidence of the use of fire by *H. erectus yuanmouensis* (Jia 1985:141; Zhou and Zhang 1984:182–185).

The absolute age of the original Yuanmou hominid fossils is still controversial (Wu Xinzhì and Wang 1985:35–37). Palaeontological studies initiated as early as the 1920s led to the Yuanmou Formation being considered a type section representing Lower Pleistocene alluvial and fluvio-lacustrine deposits in southwestern China (Teilhard 1938). Attempts to date the Yuanmou teeth on the basis of faunal correlation have yielded ambiguous results because the formation's true stratigraphic complexity, including the presence of faulted disconformities, may not have been taken into account by the original investigators (Lin et al. 1978; Liu and Ding 1983; Zhou 1988).

Attempts to resolve the problematical age of the Yuanmou Formation through palaeomagnetic determinations have, to a degree, only perpetuated this controversy (Zhou 1988; Zhou and Zhang 1984). Li Pu and his coauthors (1976) regard the stratigraphic horizon thought to have contained the Yuanmou incisors as having been formed some  $1.7 \pm 0.1$  million years ago. Subsequent reanalyses of the Yuanmou Formation's palaeomagnetic sequence have yielded dates ranging from 1.63–1.64 million years B.P. (Cheng et al. 1977) to only 0.5–0.6 million years B.P. (Liu and Ding 1983) for the presumed *Homo erectus* stratum. Li Renwei and Lin (1979) proposed that the alloisoleucine/isoleucine ratio in animal fossils suggests an age for the Yuanmou dentition of roughly 0.80 million years B.P.; however, fluctuations in the average temperature of the enclosing sediments may have had a significant effect on the reliability of these chronometric determinations.

That the fossiliferous beds of the Yuanmou Basin are crucial to our understanding of hominid evolution in southern Asia has been dramatically demonstrated since late 1986 by the discovery in Zhupeng District of more than 200 isolated primate teeth, including those of a hominid provisionally described as *Homo orientalis* sp. nov. and a new species of *Ramapithecus*, *R. hudiensis* (Jiang et al. 1987; Qian et al. 1989; Wu Xinzhì 1989a). To further complicate matters, Zhang Xingyong and his colleagues

(1989) have suggested that the Pliocene hominoid fossils from Yuanmou and elsewhere in China be redescribed as a new genus, *Sinopithecus*. It is doubtful these taxonomic classifications will be widely accepted. Investigators also report the discovery of chipped stone and bone tools as well as burned animal bones that are assumed to be associated with the remains of *Homo* at this locality.

Although a palaeomagnetically derived age of between 3.0 and 4.4 million years B.P. for the new Yuanmou fossil and cultural materials is claimed, the geological context in which they occur is described simply as "late Cenozoic"; thus the related issues of taxonomic classification, the association between hominid fossils and artifacts, as well as their absolute antiquity are not yet resolved. At present, there is no compelling reason to accept the remains of *Homo* from the Yuanmou Formation as those of any species other than *H. erectus*, nor that their antiquity exceeds the Matuyama [R] chron/Brunhes [N] chron boundary of ca. 0.73 million years ago. It is hoped that continued analysis of the intriguing new Yuanmou materials will eventually clarify these and other vexing problems.

#### *Longtandong (Hexian), Anhui*

The Longtandong (Longtan Cave) locality lies on the north slope of Wangjiashan Hill in the Taodian Commune of Hexian County, Anhui Province. Workers constructing a canal on the side of the 100-m-high hill first found Longtan Cave and its fossil-rich sediments in 1973. The importance of this locality was immediately apparent, and in 1980 a team of scientists from the Institute of Vertebrate Paleontology and Palaeoanthropology in Beijing, together with local archaeologists, began excavations of the yellowish brown sandy clay strata from which the animal remains derive (Dong 1989:17–18; Wu Maolin 1983; Wu Rukang 1985; Wu Rukang and Dong 1982).

During two periods of excavation in 1980 and 1981, remains of *Homo erectus* were recovered, including a nearly complete calvaria lacking the basioccipital region, a right supraorbital and a piece of parietal (thought to derive from different individuals than the calvaria), the fragmentary body of a mandible with two molar teeth in situ, and nine isolated teeth including a shovel-shaped upper central incisor. These remains are thought to represent at least three individuals (Day 1986; Wu Maolin 1983).

In addition to *Homo*, 47 species of mammalian fossils have been identified (Han and Xu 1989:343; Huang Wanbo et al. 1981, 1982). The Hexian fossil assemblage contains several members of the *Stegodon-Ailuropoda* fauna such as the Chinese tapir (*Tapiris sinensis*), the proboscidian (*Stegodon*), and the Chinese rhinoceros (*Rhinoceros sinensis*). Along with these typically southern forms were found many members of the northern Zhoukoudian Locality 1 Middle Pleistocene fauna as well. These include the giant beaver (*Trogontherium cuvieri*), two genera of deer (*Megaloceros pachyosteus*, *Cervus grayi*), hyaena (*Hyaena brevirostris sinensis*), bear (*Ursus arctos*), and some eastern alpine forms such as shrews (*Anourosorex squamipes*, *Blarinella quadraticauda*) (Han and Xu 1985, 1989; Wu Rukang 1985).

The biostratigraphy suggests that the Longtandong site is of Middle Pleistocene antiquity (Huang Wanbo et al. 1981, 1982). Chronological correlation with loessic and deep sea data supports a date of 150,000–400,000 years B.P. (Liu and Ding 1984b). However, if Xu Qinqi and You (1984) are correct in comparing the Hexian fauna with Layers 3–4 of Zhoukoudian Locality 1, then their corresponding correla-

tion with Oxygen Isotope Stage 8 would yield an age of 240,000–280,000 years B.P., a temporal range that Wu Rukang (1985) considers more likely.

Recent thermoluminescence (TL) determinations of the sediments in Longtan Cave from which the Hexian calvaria was excavated yield a date of  $191,000 \pm 21,000$  years B.P. (Li Huhou 1989) for the infilling of the cave; thus these TL dates do not firmly establish the date of the occupation of Longtandong by *Homo erectus*.

Comparative studies of the Hexian *Homo erectus* with the Zhoukoudian Locality 1 "Peking Man" fossils have produced invaluable data that have been used recently to fuel debates over evolutionary models for the origin of modern humans (e.g., Wolpoff et al. 1984). The suite of Asian *Homo erectus* from South to North China has been cited as evidence in support of the multiregional or regional continuity model for the origin of modern populations (Pope 1988; Wu Rukang and Dong 1985). This stands in opposition to the single area or "Garden of Eden" model proposing a late Pleistocene African origin for modern humans (for a detailed discussion of this argument see Wolpoff 1989).

The Hexian calvaria appears to be that of a male judging from its robusticity and pronounced muscular ridges. It is thought to be a young individual because of its patent sutures. The morphological similarities it shares with the Zhoukoudian *Homo erectus* include a low cranial vault, inferiorly located maximum cranial breadth, thick cranial bones, a sharply angulated occipital bone, a flattened frontal bone, a sagittal keel, a heavy and continuous supraorbital torus with a slight depression at glabella, an unobliterated metopic suture, and a cranial capacity of about 1025 cu. cm (Day 1986; Dong 1989; Wu Rukang and Dong 1982, 1985).

Certain progressive features have been noted in this specimen such as its reduced postorbital constriction and a high temporal squama with an arched parietal margin similar to that of Skull V from Zhoukoudian. Therefore, it has been suggested that the Hexian calvaria may best be compared to the later forms of *Homo erectus* at Zhoukoudian. This view is consistent with the Hexian faunal correlation to Layers 3–4 at Zhoukoudian Locality 1 that yielded *Homo erectus pekinensis* Skull V (Wu Rukang 1985).

Associations of chipped stone artifacts with the Hexian hominids remain problematical. Of interest is the presence of large flakes of mammalian enamel apparently chipped from the sides of rhinoceros molars (Huang Wanbo et al. 1981, 1982). It is thought that these flakes functioned in the same manner as their lithic counterparts and it is hoped that microscopic studies of use-wear will confirm the status of these finds as artifacts.

### *Longgupo, Sichuan*

The Longgupo (Dragon Bone Hill) limestone cave site is located near Miaoyuzhen in Wushan County, eastern Sichuan, about 15 km south of the Yangzi river at 30°45'N, 108°40'E and an elevation of 830 m (Huang Wanpo et al. 1991). Excavations conducted between 1985 and 1988 by scholars from the Chinese Academy of Sciences and the Chongqing Natural History Museum yielded about 17 m of fossiliferous strata that can be divided into upper, middle, and lower sections, according to the excavators (Huang Wanpo et al. 1991:11). Layers 5 through 8 of the middle section are of importance to us here. These strata, consisting of alluvial brownish yellow clays, sand, gravel, and a calcareous tuff separating the clay unit from the cave's limestone wall, have yielded a hominid mandibular fragment with

P<sub>4</sub>-M<sub>1</sub> intact (Layer 8), a single isolated upper central incisor (Layer 7), and two stone artifacts: a flake tool from Layer 8 and a hammerstone from Layer 5.

The rich fauna associated with the middle deposits at Longgupo is especially important because it includes the extinct hominoid *Gigantopithecus blacki* and a full range of mammalian species associated with the early Pleistocene Liucheng fauna, including *Hystrix subcristata*, *Sinomastodon* sp., *Stegodon preorientalis*, *Ailuropoda microta*, *Felis teilhardi*, *Cynailurus pleistocaenicus*, *Tapirus* sp., *Sus xiaozhu*, *S. liuchengensis*, *S. peii*, *Cervavitus ultimus*, and *Megalovis guangxiensis*. An abundant avifaunal assemblage includes *Anas* sp., *Microchierax* sp., six genera of pheasants, and a range of doves, woodpeckers, and passerines. Micromammals, such as *Mimomys peii* and *Myospalax omegodon*, are also represented. Although the occurrence of these species supports an early Pleistocene age for the middle Wushan deposit on the basis of biostratigraphic correlation, one controversial aspect of the Longgupo site's dating stems from reported chronometric dates in excess of 2 million years (Huang Wanpo et al. 1991:13). Palaeomagnetic dates from the beds containing the human fossils and artifacts yield an age of 2.01–2.04 million years B.P., while an amino acid racemization determination from mammalian tooth enamel indicates an age of about 2.39 million years B.P.

The hominid fossils from Longgupo are classified as *Homo erectus* on the basis of both their perceived antiquity as well as morphological characteristics. Both the mandibular fragment and isolated incisor have been extensively compared to other Chinese fossils of *H. erectus* (Yuanmou, Lantian, Zhoukoudian, Hexian, and Yunxian) as well as to the Sangiran hominid from Indonesia. The investigators conclude that the Wushan specimens derive from two individuals that share affinities with both the Chinese and Indonesian populations of *H. erectus* (Huang Wanpo et al. 1991:17–19).

The two stone artifacts excavated in Longgupo Cave are fashioned on water-worn andesitic porphyrite cobbles. One specimen (P.6523) is a thick primary cortical flake with two striking platforms. It is modified by limited alternate retouch and displays some evidence of use-wear (Huang Wanpo et al. 1991:20–21). The second artifact (P.6524) is a minimally modified rounded cobble exhibiting localized pitting suggesting use as a hammerstone (Huang Wanpo et al. 1991:21–23). Excavations thus far have not yielded debitage or even small utilized flakes although the recovery of bird, rodent, and bat bones indicates they were not overlooked.

The Longgupo site is extremely interesting for three primary reasons: (1) a proposed very early Pleistocene age, exceeding two million years B.P.; (2) the recovery of *Homo* and *Gigantopithecus* fossils in the same stratigraphic unit; and (3) the discovery of stone tools in a stratified cave context in association with the fossils of human ancestors and *Gigantopithecus*.

Many important questions concerning the course of human evolution in South China and the extinction of *Gigantopithecus* in the Middle Pleistocene might be answered through continued excavations at Longgupo and other localities in Wushan County, Sichuan, and adjacent territory in Hubei Province. If the reported chronometric dates for Longgupo are correct, not only would these hominid remains be the earliest known outside of Africa, they might well provide the evidence necessary to understand the degree to which human evolution in East Asia must be considered a phenomenon distinct from that of regions to the west (Ciochon et al. 1990).

*Guanyindong, Guizhou*

The Guanyindong (Guanyin Cave) is located some 152 km northwest of the provincial capital, Guiyang, in the karst landscape of Qianxi County. Four seasons of excavation have been completed in the cave since its initial discovery in 1964, yielding around 3000 artifacts, of which 2323 have been subjected to detailed analysis (Li Yanxian 1989:159–183; Li Yanxian and Wen 1978, 1986).

The cave consists of an east-west trending main chamber about 90 m long by 2–4 m wide and two smaller side chambers. The main entrance lies at the west end of the large chamber, which contains a stratified series of deposits, including archaeological remains and vertebrate fossils, over 8 m thick. The Guanyindong sequence can be divided into nine distinct horizons, of which the sandy clays of Layers 2–8 are the artifact-bearing strata. Layers 3–7 consist of fossiliferous breccia deposits that are distinguished on the basis of variation in color, degree of consolidation, and size of enclosed limestone erosional blocks. Following Li Yanxian (1989) and Li Yanxian and Wen (1978, 1986), materials recovered from the red clays of Layer 2 are referred to as Group A, and artifacts derived from Layers 3–8 are classified as Group B. The site's excavators believe that although stratigraphic relationships alone indicate that the Group A materials are later than those of Group B, there are insufficient independent grounds (e.g., artifact typology, processes of deposition, variation in associated fauna) to warrant classifying them as separate industries. It must be noted that the interpretation of the Guanyindong stratigraphic sequence is somewhat problematical, because some investigators label the Group A assemblage as "Late Stage Guanyindong Culture" and Group B as "Early Stage" (Zhang Senshui 1985:172), implying that rather more distinctions may be apparent than are currently recognized by the excavators.

Most of the Guanyindong artifacts are fashioned from siliceous limestone, although vein quartz and flint are also common raw materials with occasional pieces made on chalcedony, fine sandstone, and other cryptocrystalline rocks. In all cases, lithic raw materials seem to have come from deposits, including weathered limestone surfaces, within 2 km of the site.

Hundreds of polyhedral and single-platform cores are known from the site, very few of which show signs of any systematic preparation. The morphology of the cores and resulting flakes suggests that simple freehand direct percussion with a hard hammer was the principal means of reducing nuclei, although no percussors have yet been recovered in the cave. Some flakes bear a resemblance to those produced by block-on-block percussion, but it is not clear whether or not these are intentional. More than 60 percent of all artificially produced stone pieces had been secondarily retouched, and nearly all flakes discovered have traces of use-wear.

The general characteristics of the Guanyindong assemblage have been summarized by Zhang Senshui (1985:174–176) and Li Yanxian (1989:182) and include the following essential points:

1. Most tools are made on small (3–5 cm) irregular flakes.
2. Flakes seem to have been produced only through freehand direct percussion with a hammerstone. Occasional flakes apparently struck by the block-on-block or anvil technique are thought to be accidental.
3. Unretouched utilized flakes are very rare.
4. The proportion of finished tools is relatively high, about 60 percent of the entire

assemblage. Such a high percentage of tools is unique among known Early Palaeolithic cultures in China.

5. The assemblage is typologically simple, with scrapers the most commonly occurring tool type (Fig. 3a–b).
6. The morphology of the tools within each type varies considerably, and irregular pieces are common. Simple direct percussion retouching has generated ragged, sinuous cutting edges on most artifacts.
7. Implements with multiple working edges are more common than those with single.
8. The margins of most tools are relatively blunt, with edge angles generally exceeding 80°.
9. All categories of tools are characterized by repeated superimposed retouch.

The assemblage of vertebrate fossils excavated from Layers 3–7 in the Guanyindong belongs to a typical Middle—Upper Pleistocene *Stegodon-Ailuropoda* fauna. The presence of surviving Tertiary species in the lower layers led the cave's investigators to propose that the Group B assemblage is of early Middle Pleistocene age. This fauna indicates a palaeoenvironment somewhat warmer than that of the present. The recovery of such forms as elephant, tapir, and rhinoceros suggest that we may properly consider this environment subtropical or even tropical.

Although lithostratigraphic data are ambiguous as to the absolute age of the Group B assemblage at Guanyindong, most researchers agree that an early Middle Pleistocene to early Upper Pleistocene antiquity is indicated (Li Yanxian 1989:176–178; Li Yanxian and Wen 1978, 1986; Zhang Senshui 1985). Regardless of chronometric age, at present both the Group A and B assemblages from Guanyindong are regarded as Early Palaeolithic on typological grounds. The problem of Guanyindong's absolute antiquity is compounded by the fact that no human fossils have yet been recovered from the cave.

#### *Yanhuidong (Tongzi), Guizhou*

The striking karst topography of Guizhou Province first yielded evidence of the early human occupation of this region in 1971 with the excavation of Yanhuidong (Yanhui Cave) on the southern slope of Chaishan'gang Mountain in Yufeng Brigade, Tongzi County. Continued excavations at this locality in 1972 and, most recently, 1983 have produced an assemblage of six hominid teeth, one dozen stone artifacts, burned bones, and a wide array of mammalian fossils (Qiu Zhonglang 1985; Wu Maolin 1984).

A total of seven layers compose the cave's stratigraphic profile. All the human and mammalian fossils as well as the stone artifacts were recovered from the fourth layer of grayish yellow sand and gravel. Most of the artifacts are scrapers made on chert although a few implements are fashioned on volcanics, siliceous limestone, and quartzite as well. The technique of core reduction is simple direct percussion and the retouch on the scrapers is coarse and unidirectional. The archaeological evidence supports an Upper Pleistocene age for this assemblage (Qiu Zhonglang 1985).

The faunal remains at Yanhuidong consist mostly of isolated teeth; however, more than 25 mammalian species are represented including *Ailuropoda*, *Hylobates*, *Ursus thibetanus kokeni*, *Stegodon orientalis*, and *Rhinoceros sinensis*. The biostratigraphy is consistent with a Middle–Upper Pleistocene age range for this locality.

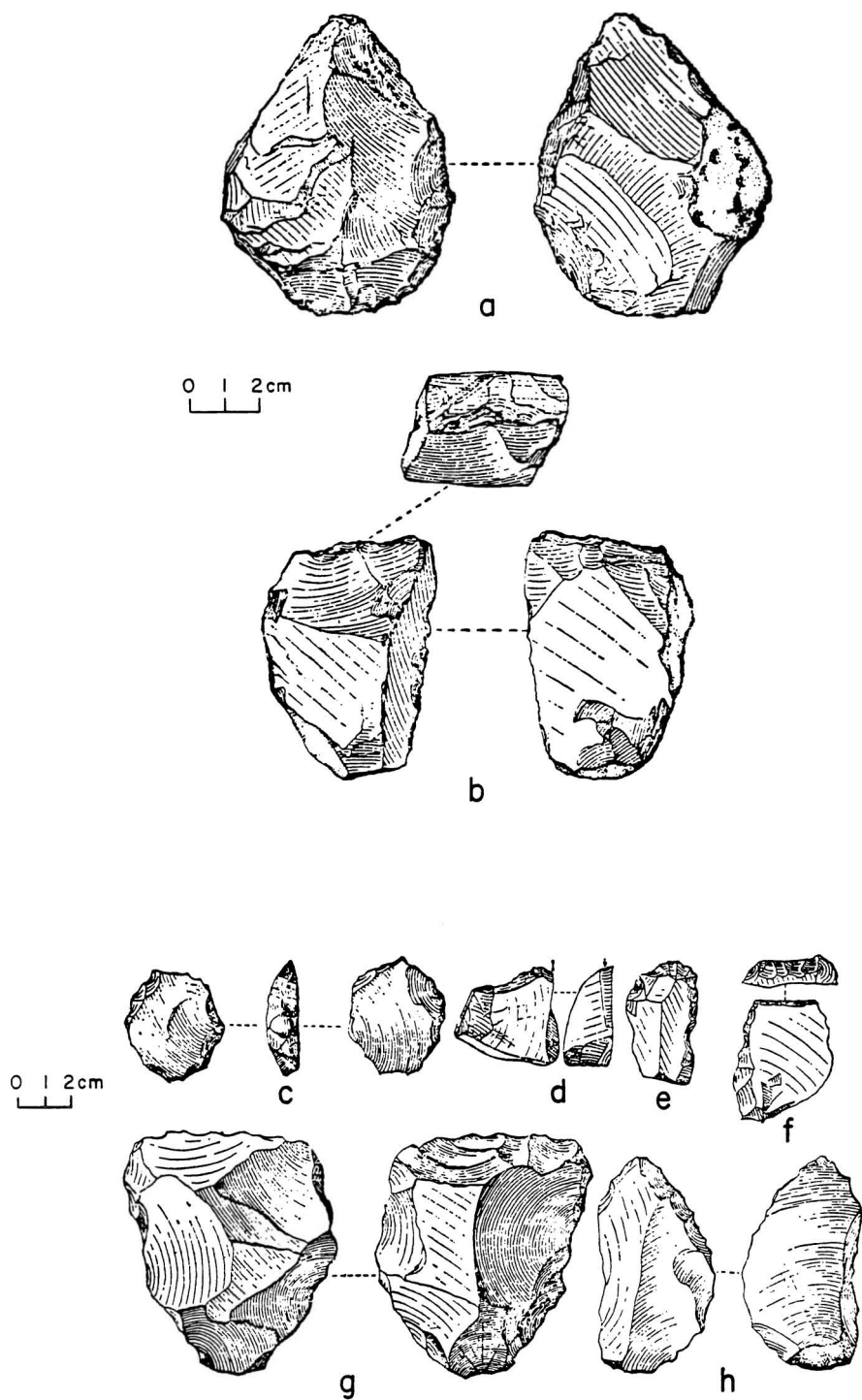


Fig. 3. *a-b*, large scrapers from the lower cultural horizon at Guanyindong, Guizhou (after Li Yanxian 1989). *c-h*, small flake tools from the Upper Pleistocene Zhang'ertang locality at Tongliang, Sichuan (after Huang Weiwen 1989).

Most recently, uranium-series dates of 172,000–192,000 years B.P. and 214,000 years B.P. have been reported for Yanhuidong by Wang Linghong (1989).

The hominid remains are a collection of isolated teeth as well. A right central upper incisor and a right first upper premolar were recovered in 1972. On the basis of their root and crown morphology, these specimens were placed in a systematic position between *Homo erectus pekinensis* and early *Homo sapiens* (Wu Xinzhi and Wu 1985). When four additional teeth including an upper canine, first premolar, and two upper first molars were discovered in 1983, the range of morphological variation was felt to be consistent with that of *Homo erectus*. All the specimens were subsequently assigned to that species (Wu Maolin 1984).

#### *Shizishan (Maba), Guangdong*

In 1958, a well-preserved hominid calotte was recovered from limestone cave deposits on Shizishan (Shizi Hill), located 1.5 km southwest of Maba Village, Shaoguan (Qujiang) County, Guangdong Province. Although there were no artifacts associated with these deposits, there was an extensive array of mammalian fossils typical of the *Stegodon-Ailuropoda* fauna (*sensu lato*) of early Upper Pleistocene antiquity (Han and Xu 1985, 1989). Represented in this assemblage are a number of large mammals including two genera of proboscidiens (*Stegodon* sp., *Palaeoloxodon namadicus*), tapir (*Tapirus* sp.), deer (*Cervus* sp.), pig (*Sus* sp.), rhinoceros (*Rhinoceros* sp.), and bovid (*Bos* sp.) (Day 1986; Wu Rukang and Peng 1959).

The Maba calotte consists of both parietals, the frontal, the nasal bones, and part of the margin of the right orbit. Although the supraorbital tori have been damaged by rodent gnawing, a generally excellent state of preservation has allowed this specimen to be extensively studied, and the resulting morphometrics and cranial indices have been compared to both *Homo erectus* and early *Homo sapiens* in an attempt to place this hominid within a developmental perspective for the Asian representatives of *Homo* (Guangdongsheng Bowuguan and Qujiangxian Bowuguan 1988; Wu Rukang and Peng 1959; Wu Xinzhi 1989b:35–36; Wu Xinzhi and Zhang Yinyun 1978).

Some morphological features of the Maba calotte are shared with Asian *Homo erectus*. For example, the configuration of the upper face, the wide nasal breadth, and the presence of sagittal keeling are similar to the Zhoukoudian Locality 1 *Homo erectus*. However, the Maba specimen is considered to be a more advanced physical type by virtue of its rounded frontal and parietal bones, thinner cranial walls, and a cranial vault that is more elevated than in *Homo erectus* but less than in modern *Homo sapiens*. The Maba calotte is presently thought to represent early *Homo sapiens* in China (Guangdongsheng Bowuguan and Qujiangxian Bowuguan 1988; Wu Xinzhi 1989b:35–36; Wu Xinzhi and Wu 1985).

#### *Ziyang, Sichuan*

During construction of the Chengdu-to-Chongqing railway in 1951, a human skull was discovered during the erection of a trestle over the Huangshanxi River in Ziyang County, western Sichuan, about 80 km southeast of Chengdu in the Sichuan Basin (Wu Xinzhi and Zhang Zhenbiao 1985:119). The cranium, classified as *Homo sapiens sapiens* (Pei 1952; Pei and Wu 1957), is perhaps South China's most famous



late human fossil, but it remains somewhat problematical as to its exact age and association with cultural remains, including a bone awl (Li Xuanmin and Zhang 1984).

The Ziyang cranium consists of a palate and partial maxilla along with small nasal fragments articulated with a nearly complete calvaria (Wu Maolin 1989:51–53). All the Ziyang specimens are thought to derive from a single individual, probably an elderly female.

Detailed anatomical descriptions of the Ziyang hominid may be found in Wu Xinzhì and Zhang Zhenbiao (1985:119) and Wu Maolin (1989:45–47, 51–53). To summarize these reports, the Ziyang cranium is relatively small and well-rounded with all its principal morphometric indices falling within the range of modern *H. sapiens*. Fluorine analysis and specific-gravity tests conducted by Qiu Zhonglang (1955) indicate that two distinct periods of deposition may be responsible for the formation of the Ziyang sequence. This fact, coupled with ambiguous radiocarbon dates (ranging from roughly 7000 to more than 37,000 years B.P.; Wu Xinzhì and Wang 1985:45) and the unclear provenance of the human fossils themselves, has led to continuing controversy over the true antiquity of these materials.

In the spring of 1981, additional construction activity yielded an assemblage of 172 stone artifacts, mammal bones, and specimens of fossil wood about 100 m northwest of where the original Ziyang hominid was found (Li Xuanmin and Zhang 1984). This new find-spot, now called Ziyang Locality B, is a pebble layer about 8 m below the present ground surface that is geologically correlated with the same fluvial terrace (T<sub>1</sub>) that produced the hominid remains (Li Xuanmin and Zhang 1984:216).

The Ziyang Locality B stone assemblage is characterized by two particular features: (1) most artifacts are very large and simply flaked and (2) the tools are usually retouched on their ventral surfaces alone or on both ventral and dorsal faces. Unifacial choppers are the most common implements (68.1 percent of the total collection of tools), although convex scrapers and morphologically variable pointed tools were also recovered (Li Xuanmin and Zhang 1984). Nearly all of the known Locality B flakes were produced by hard hammer direct percussion. These features have led Chinese investigators (Huang Weiwen 1989:241; Li Xuanmin and Zhang 1984) to conclude that the Ziyang Locality B assemblage shares its closest affinities with cultural remains from the Zhang'ertang site in Tongliang County, Sichuan.

At present, two radiocarbon dates on fossil bone and wood place the Ziyang Locality B assemblage at  $37,400 \pm 3000$  (PV-221) and  $39,300 \pm 2500$  (PV-160) B.P., well within the late Upper Pleistocene. Other sites in Ziyang County that have yielded small collections of artifacts and animal fossils include Liyuqiao (Beijing Daxue Lishixi Kaogu Yanjiushi and Sichuansheng Bowuguan 1983), Shixiazi, and Shaju (Sichuansheng Wenwu Guanli Weiyuanhui 1983). The Liyuqiao locality has an associated carbon-14 date of  $25,100 \pm 400$  B.P.

#### *Tongliang, Sichuan*

The Zhang'ertang site, located about 110 km northwest of Chongqing in Tongliang County (Jia and Huang 1985:219; Li Yanxian 1989:181–183; Zhang Senshui et al. 1982) has produced an assemblage of stone artifacts thought by many to closely resemble the Guanyindong industry from western Guizhou (Fig. 3c–h). Li Xuanmin and Zhang Senshui (1981) have even proposed that a general congruence in artifact

types and flaking technology requires archaeologists to consider the Guanyindong and Tongliang sites as members of a common cultural heritage.

The Zhang'ertang assemblage, including over 300 artifacts, was found in 1976 buried in Upper Pleistocene bog facies within a lacustrine basin. The artifacts were made principally on quartzite (nearly 75 percent) and flint flakes struck from multiple platform nuclei using simple hard hammer direct percussion and the anvil (or block-on-block) technique. The Tongliang tools are relatively large (57 percent are larger than 60 mm in their longest dimension; only 11 percent are less than 40 mm long) and include both unifacial choppers and bifacial pebble chopping tools as well as a wide variety of scrapers and pointed implements (Huang Weiwen 1989:240). Fabrication techniques include rather crude abrupt retouch, resulting in tools with relatively blunt edges, most of which exceed 80°. This particular combination of characteristics is cited by Li Xuanmin and Zhang (1981) as providing evidence of the links between the Tongliang and Guanyindong industries. Although the two assemblages share technological features, the Guanyindong artifacts are considerably smaller. Investigations that emphasize the availability of raw material and the role of natural site formation processes would be extremely helpful in determining the extent of the affinities between these lithic collections.

Both animal and plant fossils from the Zhang'ertang locality have yielded radiocarbon dates ranging from  $21,550 \pm 310$  B.P. near the top of the sequence (Li Xuanmin and Zhang 1981) to  $25,450 \pm 850$  in the lower deposit (Wu Xinzhi and Wang 1985:45-46), suggesting that the Tongliang assemblage dates to the period immediately before and just within the last glacial maximum. Although no human fossils have yet been discovered at Zhang'ertang, the site's abundant *Stegodon-Ailuropoda* fauna provides biostratigraphic corroboration of this proposed age.

#### *Bose Basin, Guangxi*

In 1973, several chipped stone tools were discovered on the third terrace of the Youjiang River near Shangsongcun in the Bose (or Baise) Basin of the Guangxi Zhuang Autonomous Region. Li Yanxian and You Yuzhu (1975) described these artifacts as being of probable Late Palaeolithic affinity. Since 1977, many scholars working in Bose, Tiandong, Tianyang, and other counties in the Bose District have discovered more than 2000 additional stone tools at about ten localities. Most of these finds come from surface or eroded stratigraphic contexts, but a minority were recovered in what appears to be primary context (Li Yanxian 1989:192).

The Bose assemblages are fashioned for the most part on sandstone cobbles and include a characteristic suite of southern Palaeolithic tool types including scrapers, unifacial choppers, and flakes derived from pebbles. What makes the Youjiang River third terrace localities of special interest is the recovery of large bifacial implements described by investigators as "hand axes" (Ceng 1983; Huang Weiwen 1987). These large tools, measuring up to 38.3 cm in length, certainly constitute a typological category distinct from their nearest relatives, the bifacial "chopping-tools" that are such a common element in Chinese Palaeolithic industries (Fig. 2d). The Bose bifaces, although retaining perhaps a third of their original pebble cortex in most cases, are all very large implements and seem to represent a fabrication strategy that is not merely a function of consistently larger raw material.

The absence of human fossils and clearly associated faunal remains has compli-

cated the dating of the Bose localities, although most investigators are in agreement that they are of Pleistocene antiquity. Several scholars have proposed that the artifacts derived from buried contexts in the Youjiang River third terrace are of Middle Pleistocene age (Huang Weiwen 1987; Huang Weiwen et al. 1988); however, there is no consensus on this point and even the authors admit that much more work needs to be done before an accurate chronology can be reconstructed.

*Tongtianyan (Liujiang), Guangxi*

In September 1958, farm workers digging for phosphorus fertilizer in a small cave at Tongtianyan, about 16 km southwest of Liuzhou in the Guangxi Zhuang Autonomous Region, discovered a remarkable collection of human fossils. The skeletal remains include a nearly complete skull lacking only the mandible and fragments of both zygomatic arches, the lower four thoracic vertebrae with four articulated rib fragments, all five lumbar vertebrae, the sacrum, the right innominate, and two femur fragments (Wu Rukang 1959).

Representatives of the *Stegodon-Ailuropoda* fauna were also found in the cave, including the bones and teeth of *Ailuropoda*, *Hystrix*, *Rhinoceros sinensis*, *Stegodon*, *Megatapirus*, *Sus*, and *Ursus*. These abundant mammalian fossils were found in hard yellowish deposits thought to be Middle Pleistocene in age (Wu Xinzhì and Zhang Zhenbiao 1985). The human fossils, however, were found near the entrance of the cave in association with the complete skeleton of a giant panda (*Ailuropoda*), both embedded in a matrix of loosely consolidated limestone breccia intercalated with grayish brown sands and clays (K. C. Chang 1962). Wu Rukang (1959) believes that these deposits postdate the rest of the faunal remains and suggests a late Pleistocene age for the fully modern Liujiang hominid.

The human fossils are described in detail, along with metric measurements and cranial indices, in Wu Rukang (1959), Wu Xinzhì and Zhang Zhenbiao (1985), and Wu Maolin (1989:49–51). These investigators believe the Liujiang cranium exhibits more primitive morphological features than both the Zhoukoudian Upper Cave and Ziyang hominids. They also suggest that the morphometric characteristics of the Liujiang cranium reflect both Mongoloid and Australoid racial affinities.

Interpretations of the postcranial remains have been a source of controversy since their discovery, but Howells (1977) maintains that their overall size in relation to the skull is consistent with Wu Rukang's (1959) assessment of their "proto-mongoloid" affinities. A stature determination based on a femoral segment yielded a calibrated height of  $156.56 \pm 3.74$  cm, somewhat shorter than the average stature for extant South China populations (Wu Xinzhì et al. 1984).

*Baojiyan, Guangxi*

In the spring and summer of 1979 a small collection of 12 chipped stone artifacts and two fossil human teeth were excavated in Baojiyan rockshelter in the Guilin karst region of the Guangxi Zhuang Autonomous Region (Wang Linghong et al. 1982).

Unearthed from gray-yellow sediments in association with an Upper Pleistocene *Stegodon-Ailuropoda* fauna, the Baojiyan human and cultural remains represent the first such discovery within a well-defined biostratigraphic context in Guangxi. The human teeth (a lower right second molar and a lower left third molar) are classified

as *Homo sapiens sapiens* on the basis of their modern morphology and provenance (Wang Linghong et al. 1982:32).

The Baojiyan lithic assemblage includes seven cores, all made on quartz pebbles with no evidence of platform preparation. Four bifacial chopping tools were discovered including specimens with straight, convex, and elliptical working edges. The elliptical specimen (KP-79703) in particular exhibits relatively careful trimming on both surfaces. A single, rather amorphous semilunar convex scraper (KP-79704), apparently fashioned on an exhausted core, was also discovered in Baojiyan. These implements all seem to have been produced by the simple direct percussion technique.

Although the investigators (Wang Linghong et al. 1982:34–35) suggest that typological similarities exist between the Baojiyan assemblage and chipped stone tools found recently in the Bose Basin of Guangxi (Li Yanxian 1989:194), the limited sample sizes and a lack of chronometric dates at Baojiyan leave this assertion open to investigation.

### *Maomaodong, Guizhou*

The Maomaodong, or Maomao Cave, located in Xingyi County, Guizhou Province, on the upper reaches of the Zhujiang (Pearl River), was excavated in 1974 (Cao 1982a, 1982b; Zhang Senshui and Cao 1980). From deposits totaling over 60 m in depth, about 4000 stone artifacts, 14 bone and antler implements, and seven human fossils have been recovered in association with a rich vertebrate faunal assemblage and evidence for the utilization of fire (Huang Weiwen 1989:241–242).

Unfortunately, the human remains from the cave are so fragmentary that little can be said except that they appear to derive from a single modern *Homo sapiens* individual. It is unclear whether or not these bones represent an intentional interment directly associated with the cave's cultural assemblage, or simply a random inclusion.

The Maomaodong lithic assemblage, fashioned on a wide range of raw materials including quartz and quartzite, mudstone, and flint collected from nearby riverbeds and outcroppings, is characterized by flakes produced by direct hard-hammer percussion and percussion on an anvil. Resulting flakes are relatively small (less than 100 mm in length), with choppers, pointed tools, and scrapers dominating the finished tool category. Huang Weiwen (1989:242) notes that some of the tools from Maomaodong are so symmetrical and precisely retouched that they closely resemble the late Palaeolithic industries from Qingshuihe, Inner Mongolia, and Hutouliang in Hebei Province, both far to the north of Maomaodong. That the presence of flint in the Maomaodong assemblage has permitted the fabrication of comparatively symmetrical tools superficially resembling those from North China where such quality raw materials occur in relative abundance, must be seriously considered.

The bone tools from Maomaodong, although numbering only 14 specimens, are clearly the product of early humans (Cao 1982b). Various combinations of percussion, cutting, scraping, and grinding have all left distinct traces of the manufacturing process on these tools. Five bone awls have been recovered displaying a wide range of overall shapes and point morphologies, suggesting that they may have been employed in a broad spectrum of activities. A single bone knife, flaked and ground

from a segment of large mammalian long-bone diaphysis, seems rather opportunistic, although until additional specimens are recovered this must remain speculative. The eight antler artifacts recovered at Maomaodong are referred to as "spades" by the excavator (Cao 1982b), but these tools, fashioned by beveling one surface of the distal ends of antler tines, seem rather to have functioned as burnishing implements or even small adzes or wedges. These antler tools are not spatulate as one would expect a spade to be, although it is possible that they may have been used as digging implements of some sort. Presumably, microscopic analysis of use-wear traces on the working edges of these implements will one day resolve the issue of their function.

Whereas sophisticated bone and antler implements have an apparently long history of manufacture and use in North China, extending back well beyond the last glacial maximum (e.g., Huang Weiwen 1989:232–233), the Guizhou finds are essentially unique in the South Chinese Palaeolithic. Taking into account differences in circumstances of preservation in the north and the south, one must nonetheless regard the Maomaodong bone assemblage as especially significant in this regard until additional finds are made.

The archaeological remains from Maomaodong have been dated by a single uranium series determination on a fossil deer tooth to  $14,600 \pm 1200$  B.P. (Wang Linghong 1989:402; Zhang Senshui 1983); however, a carbon-14 date on burned bone from the same stratum yielded a range of only  $8820 \pm 130$  B.P. and two radiocarbon dates, also on burned bone, from the "Upper Cultural Layer" are reported at  $8080 \pm 100$  and  $8670 \pm 100$  B.P. (Huang Weiwen 1989:242). The internal consistency among these radiocarbon determinations as well as the related problems of leaching and secondary uptake of uranium calls into question the reliability of the earlier U-series date.

#### *Baiyanjiao (Puding), Guizhou*

The cave site of Baiyanjiao in Puding County, Guizhou Province, was excavated over two seasons in 1979 and 1982 (Li Yanxian and Cai 1986a, 1986b, 1986c). More than 1500 stone artifacts, two bone tools, and a wide variety of faunal remains were recovered from the 2-m-thick cave deposits. A total of eight stratigraphic layers have been defined. Layers 2–7 are associated with an Upper Palaeolithic industry that has yielded radiocarbon dates of  $14,200 \pm 200$  and  $14,630 \pm 200$  B.P. from Layer 5 and  $12,080 \pm 200$  and  $11,740 \pm 200$  B.P. from Layer 3.

The Baiyanjiao lithics are fashioned on chert, siliceous limestone, sandstone, and quartz and were produced by both hard hammer percussion and bipolar flaking techniques. The assemblage includes 400 scrapers with a variety of edge morphologies, 43 choppers and chopping tools, two backed knives, four endscrapers, 20 points, five burins, and notched tools (Chen and Olsen 1990; Huang Weiwen 1989:238–239; Li Yanxian and Cai 1986b, 1986c).

Mammalian remains of *Stegodon* (*S. orientalis*), giant tapir (*Megatapirus augustus*), Chinese rhinoceros (*Rhinoceros sinensis*), giant panda (*Ailuropoda melanoleuca*), deer (*Cervus* sp.), Tibetan black bear (*Ursus thibetanus*), pig (*Sus* sp.), and tiger (*Felis tigris*) represent the *Stegodon-Ailuropoda* faunal suite widely distributed in late Pleistocene South Chinese cave deposits.

*Mujiaqiao, Yunnan*

In the early 1960s an open-air locality known as the Mujiaqiao site, located on the Jinshan Commune in Lijiang Naxi Autonomous County in northern Yunnan Province, yielded a small collection of six chipped stone tools in association with a typical Upper Pleistocene fauna (Li Youheng 1961; Lin and Zhang 1978). Then, in 1964, a nearby locality produced the partial cranium of a fully modern *Homo sapiens sapiens*, the so-called "Lijiang Man" (Yunnansheng Bowuguan 1977). Subsequent investigations at Mujiaqiao in the spring of 1984 brought to light additional mammalian fossils as well as 16 tools that add an important typological element to the discussion of the Southwest Chinese Palaeolithic (Wei et al. 1984).

Located near Tianxin Village, at the southern margin of the Lijiang Basin, the Mujiaqiao site contains a 35-m section of sedimentary deposits that includes 0.5- to 3-m-thick sand-gravel strata in which artifacts and fossils were found in two locations.

The Mujiaqiao stone assemblage is not typologically diverse. All known implements are fashioned either directly on pebbles or on flakes derived from unprepared pebble cores. Both single and double platform cores are known from the most recent Mujiaqiao investigations (Wei et al. 1984), although Lin and Zhang (1978) reported the discovery of a multiple platform core at the site as well. Convex and concave side scrapers fashioned on thick flakes and a single pebble chopper complete the Mujiaqiao assemblage with the exception of five stone spheroids discovered in 1984 (Wei et al. 1984:230-231). These balls, carefully made by flaking off the cortex of naturally rounded cobbles of several raw materials, are of uncertain function at present. Their morphology alone is of interest because before their discovery at Mujiaqiao, stone spheroids were thought to be a purely North Chinese Palaeolithic phenomenon. They are a well-known artifact in sites such as the early Upper Pleistocene Xujiayao and Dingcun localities in North China's Shanxi Province. The Mujiaqiao stone balls, ranging in diameter from roughly 75 mm to more than 100 mm, strongly resemble their North Chinese counterparts, although as Wei and his coauthors (1984) point out, interpretations as to the connections between widely separated areas formulated on the basis of such a small sample of finds must be limited.

Although Li Youheng (1961) and Wei et al. (1984) describe two possible "antler tools" from Mujiaqiao, all are cautious in their interpretation of these finds. At present, their status as artifacts remains in question.

No chronometric dates yet exist for the Lijiang assemblages, although geological correlation and biostratigraphy both suggest the Mujiaqiao materials are of Upper Pleistocene antiquity.

*Fulin, Sichuan*

The Late Palaeolithic in South China is characterized by a greater variety of lithics and an increase in technological expertise over earlier periods. Both of these characteristics are evident at the site of Fulin, located in a mountainous basin at an elevation of 790 m in Hanyuan County, Sichuan (Yang 1961). In 1972, more than 5000 stone artifacts were excavated from an ancient terrace, 20-25 m above the present bed of the nearby Dadu River at Fulin Village (Chen and Olsen 1990; Huang Weiwen 1989:238).

The most striking feature of the Fulin assemblage is its small size. The tools average just 19.5 mm in length by 15.5 mm in width by only 6 mm in thickness. Tiny blades and scrapers made on pebbles are abundant and many flakes exhibit trimmed platforms. The raw material is mostly black chert but there are several small, finely retouched scrapers made on crystalline quartz as well. Hard hammer percussion and the bipolar method are the two main flaking techniques and there are large quantities of debitage in the assemblage indicating that tool manufacture took place locally (Chen and Olsen 1990). Use-wear studies might shed some light on the function of this small tool assemblage, but particular care in the analysis must be taken to distinguish use-wear from natural abrasive processes on the thin vitreous edges of many implements.

There is no absolute age determination available for the Fulin site and faunal remains are sparse, consisting of only a few fragments of *Ursus thibetanus*, *Sus* sp., *Rusa*, *Muntiacus* sp., and an unidentified mollusk. On the basis of this biostratigraphy, Fulin is thought to date to the last phase of the Late Palaeolithic (Jia and Huang 1985), but it could prove to be as early as the last glacial maximum (18,000–22,000 B.P.) (Chen and Olsen 1990).

Fulin remains the only nonmicrolithic small tool assemblage so far discovered in South China and, as such, occupies a unique place in continuing studies of the development of regional cultural variants in Late Pleistocene China.

#### *Zhangzhou District, Fujian*

The discovery, beginning in 1985, of Pleistocene localities in the vicinity of Zhangzhou, on the southeast coast of Fujian (You 1991), are among the most important made in South China in the past decade. Before the discovery of these sites, all of Fujian was a blank on our map of the Pleistocene cultures of China, a circumstance made all the more difficult to understand by the recovery in the 1970s of fossil human remains on Taiwan.

Thus far, a team of field workers from the Chinese Academy of Sciences and the Fujian Provincial Museum have recovered three human fossils and 27 stone artifacts (the "Lower Layer Culture") in a geological context the investigators believe corresponds with the middle Upper Pleistocene, more than 40,000 years B.P. In addition, a 100-square-km area around Zhangzhou has yielded 113 localities that have produced thousands of artifacts (of which slightly more than 1450 have been analyzed) dating to the terminal Pleistocene or early Holocene (the "Upper Layer Culture" or "Zhangzhou Culture").

The fossilized human remains from Zhangzhou District include an adult male left tibia diaphysis fragment discovered in 1990 at Locality 63 in the city's north suburbs, an adult distal right humerus fragment recovered in 1987 from uncertain Pleistocene–Holocene transitional sediments in Dongshan County, and a lower left first molar (age and sex undetermined) excavated in 1988 in Huli Cave, Qingliu County (You 1991:61–66). All of these specimens are assigned to *Homo sapiens sapiens* based on both their morphology and chronology.

The Lianhuachishan and Zhulinshan localities are open-air sites discovered in 1989 in the north suburbs of Zhangzhou City. Although neither site has yielded human fossils, Palaeolithic tools have been recovered and the stratigraphy of both sites closely resembles the sedimentary context in which the fossils described above

were found elsewhere in the Zhangzhou District. The artifacts from Lianhuachishan and Zhulinshan derive from a gravel lens sandwiched between late Pleistocene laterite beds that are associated with infinite  $^{14}\text{C}$  dates (exceeding 40,000 years B.P.). An associated typical *Ailuropoda-Stegodon* fauna also supports a middle Upper Pleistocene antiquity for the artifact-bearing horizons. Although the sample size of artifacts is very small (23 from Lianhuachishan and only four from Zhulinshan), some preliminary generalizations may be made about this stone industry. Raw materials include quartz, crystal, vein quartz, and indurated sandstone in the lower units and flint in the upper. Some patterning in these industries is apparent with the "Lower Layer Culture" being characterized by relatively large tools (unifacial choppers and complex scrapers) and utilized flakes derived from simple, multiple-platform cores. The later "Upper Layer Culture" or "Zhangzhou Culture" industry is a smaller, more refined collection including many varieties of scrapers, gravers, borers, and projectile points that average between 10 and 25 mm in length.

The significance of the Zhangzhou sites is two-fold. Not only are localities such as Lianhuachishan and Zhulinshan the first known Palaeolithic sites in Fujian, they also provide important links with previously known Pleistocene-age human fossils from Taiwan (Lian 1981; Ozaki et al. 1978; Shikama et al. 1976). Our current understanding of the prehistoric relationships between Taiwan and what is now the Chinese mainland is poor. The chronology and extent of the Dongshan Land Bridge that connected Taiwan and the mainland during periods of the Pleistocene are not well known; however, the identification of a late Palaeolithic sequence in Fujian with possible temporal and typological links to Taiwan (the so-called "Changbin Culture") gives archaeologists a firmer basis upon which to formulate hypotheses concerning the initial peopling of Taiwan as well as to expand our knowledge of southeastern coastal adaptations during the later Pleistocene.

The fact that the earliest sites identified in the Zhangzhou region occur in lateritic sediments is itself significant. Although these red soils are widely distributed throughout southern China, little attention has been paid to the fact that they might contain archaeological traces of Pleistocene antiquity. You Yuzhu and his colleagues (1991) have quite literally opened up fertile new ground for archaeological exploration in South China through their pioneering work in Fujian.

#### *Cailiaoxi, Zuozhen, Taiwan*

Downcutting by the Cailiao River, which runs through Zuozhen in Tainan County on the west coast of Taiwan, has exposed a rich series of vertebrate fossil beds that, in 1972, yielded its first evidence of fossil humans (Lian 1981; Wu Maolin 1989:56). Seven cranial fragments and two molar teeth were recovered from the two localities of Chouqu and Gangzilin. These finds have been reported on in detail in Shikama et al. (1976) and Ozaki et al. (1978).

Three cranial fragments and one of the molar teeth show heavy fossilization, and an age of 20,000 to 30,000 years old was estimated for these specimens on the basis of fluorine and manganese methods (Lian 1981). These remains have been assigned to *Homo sapiens sapiens*. The remaining four cranial fragments and the other molar tooth show virtually no mineralization and Lian (1981) suggests that they are much more recent than the other finds.

No Palaeolithic cultural remains have yet been found in association with these



early humans. Lian (1981) points out that there is a lack of suitable raw material in this part of the Taiwanese west coast with which to manufacture stone tools and she suggests that "Zuozhen Man" may have used materials other than stone to fashion tool kits. Lian (1981) reports that fragments of animal bone bearing signs of possible human modification that are chronologically older than the human remains have been found.

#### DISCUSSION AND CONCLUSIONS

In 1943, Weidenreich proposed a demonstrable evolutionary continuity between *Homo erectus* and modern Mongoloid populations. The expanding hominid fossil record from southern China is critical to this thesis, but its interpretation is initially dependent upon the resolution of several chronological problems. Among the most pressing is a long-standing debate over the Yuanmou Formation's palaeomagnetic sequence, which has yielded a range of dates from 1.7 million years ago to 0.5 million years ago. This chronological problem is compounded by circumstantial rather than direct evidence of the association between the lithics and the original hominid materials. Similar associative problems plague the 1986 discoveries in the Zhupeng District of the Yuanmou Basin. We maintain that a Middle Pleistocene age for this material is currently the most parsimonious.

The palaeomagnetic dates reported for the Longgupo (Wushan) remains exceed 2 million years (Huang Wanpo et al. 1991). A confirmation of these dates and the hominid status of the mandibular fragment would make the Wushan fossils the earliest evidence of *Homo erectus* outside of Africa, extending the antiquity of human occupation in this region to the Pliocene–Pleistocene boundary. Demonstrating an evolutionary continuity for the Asian hominids through this temporal span rests on clarifying the relationship of "progressive" *Homo erectus* specimens such as the Hexian calvaria with the suite of Southeast Asian hominids, especially the Ngandong fossils. Resolution of the taxonomic status of these fossils at present remains peripheral to understanding the technological variability in the Southern Chinese Palaeolithic, as Allen (1991) has suggested for Island Southeast Asia. An examination of the technological nature of South Chinese chipped stone assemblages must address the issue of lithic raw material use and constraints and the natural formation processes affecting assemblage composition.

Our report has demonstrated that there is considerable variability in South China lithic assemblages throughout the Pleistocene and the previously accepted patterns of diachronic change for specific implements (e.g., scrapers becoming smaller through time) must be questioned for both Northern and Southern Chinese lithic assemblages. This inhomogeneity emphasizes the problem in distinguishing a tripartite temporal division for the Palaeolithic on typological grounds. For example, the Middle Pleistocene Guanyindong assemblage is dominated by small, light-duty tools, mostly scrapers with extensive retouch while the late Upper Pleistocene Tongliang scrapers have very similar attributes of extensive retouch and steep, multiple working edges but are generally larger than the Guanyindong artifacts. There is no increase in regularity of form through time for these two collections of scrapers.

Several scholars, including Boriskovsky (1966), Hutterer (1977), Lian (1981), and Pope (1988, 1989) have argued that bamboo and hardwoods, which enjoyed a widespread distribution in Southeast Asian forest habitats throughout the Pleistocene,

may have served as important resources upon which prehistoric nonlithic technologies were based. These versatile materials could have furnished not only flaked tools, but also cooking and food storage containers, spears, traps, and rope. Some authors (e.g., Hutterer 1985; Pope 1989) suggest that the objective of the Asian chopper/chopping tool tradition was principally to produce stone flakes used to manufacture and maintain nonlithic tool kits. This explanation is consistent with the persistence of chopper/chopping tools and large pointed implements through the Pleistocene from the earliest assemblages into the late Upper Pleistocene in association with fully modern humans as at Ziyang, Sichuan. The long temporal range of this tool tradition may also reflect the relative stability of the Southern Chinese palaeoenvironment since the middle Lower Pleistocene (Xue 1991).

The extent to which these large heavy-duty implements represent one aspect of a multi-component tool kit including a variety of smaller stone implements as well as bone tools at some localities must, in part, be a function of various site formation processes such as differential preservation and fluvial sorting. Investigating these taphonomic questions is a necessary preliminary step to understanding technological development in southern China through the Pleistocene.

#### ACKNOWLEDGMENTS

The authors would like to thank Doris Sample for her assistance in preparation of the manuscript and Barbara Montgomery for drafting the map.

#### REFERENCES

- AIGNER, J. S.  
1981 *Archaeological Remains in Pleistocene China*. Forschungen zur Allgemeinen und Vergleichenden Archäologie, Band 1. Munich: Verlag C. H. Beck.
- ALLEN, H.  
1991 Stegodonts and the dating of stone tool assemblages in Island Southeast Asia. *Asian Perspectives* 30(2):243–265.
- BEIJING DAXUE LISHIXI KAOGU YANJIUSHI AND SICHUANSHEG BOWUGUAN  
1983 Sichuan Ziyang Liyuqiao Jiushiqi didian fajue baogao. *Kaogu Xuebao* 3:331–345.
- BORISKOVSKY, P. I.  
1966 *Pervobytnoe Proshloe V'etnama*. Moscow: "Nauka."
- CAO ZETIAN  
1982a Maomaodong Jiushiqi zhi yanjiu. *Gu Jizhuidongwu yu Gu Renlei* 20(2):155–164.  
1982b Maomaodong de guqi he jiaoqi yanjiu. *Renleixue Xuebao* 1(1):36–41.
- CENG XIANGWANG  
1983 Guangxi Bose diqu xin faxian de Jiushiqi. *Shiqian Yanjiu* 2:81–88.
- CHANG, K. C.  
1962 New evidence on fossil man in China. *Science* 136:749–760.  
1986 *The Archaeology of Ancient China*, 4th ed. New Haven: Yale University Press.
- CHEN CHUN AND JOHN W. OLSEN  
1990 China at the last glacial maximum, in *The World at 18,000 B.P. Vol. 1*: 276–295, ed. Olga Soffer and Clive Gamble. London: Unwin Hyman.
- CHENG GUOLIANG, LI SULING, AND LIN JINLU  
1977 "Yuanmou Ren" de niandai he Songshan [Matuyama] zaoqi shijian de shangque. *Dizhi Kexue* 1:34–43.
- CIOCHON, R. L., J. W. OLSEN, AND J. JAMES  
1990 *Other Origins*. New York: Bantam Books.

- CLARK, G. A., AND S. YI  
 1983 Observations on the Lower Palaeolithic of northeast Asia. *Current Anthropology* 24(2):181–202.
- DAY, M.  
 1986 *Guide to Fossil Man*. Chicago: University of Chicago Press.
- DONG XINGREN  
 1989 Zhongguo de zhiliren, in *Zhongguo Yuangu Renlei*: 9–23, ed. Wu Rukang, Wu Xinzhì, and Zhang Senshui. Beijing: Kexue Chubanshe.
- GUANGDONGSHENG BOWUGUAN AND QUJIANGXIAN BOWUGUAN  
 1988 *Jinian Maba Ren Huashi Faxian Sanshi Zhounian Lunwenji*. Beijing: Wenwu Chubanshe.
- HAN DEFEN AND XU CHUNHUA  
 1985 Pleistocene mammalian faunas of China, in *Palaeoanthropology and Palaeolithic Archaeology in the People's Republic of China*: 267–289, ed. Wu Rukang and J. W. Olsen. Orlando: Academic Press.  
 1989 Zhongguo nanfang Disiji purudongwu jianlun yuanzhirenlei de shenghuo huanjing, in *Zhongguo Yuangu Renlei*: 338–391, ed. Wu Rukang, Wu Xinzhì, and Zhang Senshui. Beijing: Kexue Chubanshe.
- HOWELLS, W. W.  
 1977 Hominid fossils, in *Paleoanthropology in the People's Republic of China*: 67–78, ed. W. W. Howells and P. J. Tschitani. Washington, D.C.: National Academy of Sciences.
- HU CHENGZHI  
 1973 Yunnan Yuanmou faxian de yuanren yachi huashi. *Dizhi Xuebao* 1:65–71.
- HUANG WANBO, FANG DUSHEN, AND YE YONGXIANG  
 1981 Anhui Hexian Longtandong faxian de yuanren tougaigu de guancha. *Kexue Tongbao* 26:1508–1510.  
 1982 Anhui Hexian yuanren huashi ji youguan wenti de chubu yanjiu. *Gu Jizhuidongwu yu Gu Renlei* 20(3):248–256.
- HUANG WANPO, FANG QIREN, AND OTHERS  
 1991 *Wushan Yuanren Yizhi*. Beijing: Haiyang Chubanshe.
- HUANG WEIWEN  
 1987 Zhongguo de shoufu. *Renleixue Xuebao* 6(1):61–68.  
 1989 Zhongguo Jiushiqishidai wanqi wenhua, in *Zhongguo Yuangu Renlei*: 220–244, ed. Wu Rukang, Wu Xinzhì, and Zhang Senshui. Beijing: Kexue Chubanshe.
- HUANG WEIWEN, LIU YUAN, LI CHAORONG, YUAN XIAOFENG, ZHANG ZHENHONG, CENG XIANGWANG, AND XIE GUANGMAO  
 1988 Baise shiqi de shidai wenti, in *Jinian Maba Ren Huashi Faxian Sanshi Zhounian Lunwenji*: 95–101, 236–237, ed. Guangdongsheng Bowuguan and Qujiangxian Bowuguan. Beijing: Wenwu Chubanshe.
- HUANG YUKUN AND CHEN JIAJIE  
 1988 Sea level changes along the coast of the South China Sea since late Pleistocene, in *The Palaeoenvironment of East Asia from the Mid-Tertiary*: 289–318, ed. P. Whyte, J. S. Aigner, N. G. Jablonski, G. Taylor, D. Walker, P. X. Wang, and C. K. So. Hong Kong: Centre of Asian Studies, University of Hong Kong.
- HUTTERER, K.  
 1977 Reinterpreting the Southeast Asian Palaeolithic, in *Sunda and Sahul: Prehistoric Studies in Southeast Asia, Melanesia and Australia*: 31–71, ed. J. Allen, J. Golson, and R. Jones. London: Academic Press.  
 1985 The Pleistocene archaeology of Southeast Asia in regional context. *Modern Quaternary Research in Southeast Asia* 9:1–25.
- IKAWA-SMITH, F.  
 1978 *Early Paleolithic in South and East Asia*. The Hague: Mouton.
- JIA LANPO  
 1985 China's earliest Palaeolithic assemblages, in *Palaeoanthropology and Palaeolithic Archaeology in the People's Republic of China*: 135–145, ed. Wu Rukang and J. W. Olsen. Orlando: Academic Press.

JIA LANPO AND HUANG WEIWEN

- 1985 The late Palaeolithic of China, in *Palaeoanthropology and Palaeolithic Archaeology in the People's Republic of China*: 211–223, ed. Wu Rukang and J. W. Olsen. Orlando: Academic Press.

JIANG NENGREN, SUN RONG, AND LIANG QIZHONG

- 1987 Yuanmou zaoqi yuanren (yachi huashi) de faxian jiqi yiyi. *Yunnan Dizhi* 6:157–162.

LI HUHOU

- 1989 Absolute dates and dating methods, in *Proceedings of the Circum-Pacific Prehistory Conference 1, Human Evolution in the Pacific Region*: 1–7, compiled by G. Krantz, C. K. Ho, and M. Stoneking. Seattle: Circum-Pacific Prehistory Conference.

LI PU, QIAN FANG, MA XINGHUA, PU QINGYU, XING LISHENG, AND JU SHIQIANG

- 1976 Yong gudici fangfa dui Yuanmou Ren huashi niandai de chubu yanjiu. *Zhongguo Kexue* 6:579–591.

LI RENWEI AND LIN DAXING

- 1979 Woguo "Beijing Ren," "Lantian Ren" he "Yuanmou Ren" chandi guhuashi zhong anjisuan de diaihua. *Dizhi Kexue* 1:56–61.

LI XUANMIN AND ZHANG SENSUI

- 1981 Tongliang Jiushiqi wenhua zhi yanjiu. *Gu Jizhuidongwu yu Gu Renlei* 19(4):359–371.  
1984 Ziyang Ren B-didian faxian de Jiushiqi. *Renleixue Xuebao* 3:215–224.

LI YANXIAN

- 1982 Hua'nán Jiushiqishidai de xiangdui niandai. *Renleixue Xuebao* 1(2):160–168.  
1989 Zhongguo nanfang Jiushiqishidai zaoqi wenhua, in *Zhongguo Yuangu Renlei*: 159–194, ed. Wu Rukang, Wu Xinzhi, and Zhang Sensui. Beijing: Kexue Chubanshe.

LI YANXIAN AND CAI HUIYANG

- 1986a Guizhou Puding Baiyanjiaodong Jiushiqishidai yizhi. *Renleixue Xuebao* 5(2):162–171.  
1986b Baiyanjiaodong shiqi leixing de yanjiu. *Renleixue Xuebao* 5(4):317–324.  
1986c Guizhou Baiyanjiaodong shiqi de di'er bu jiagong. *Jiang-Han Kaogu* 2:56–64.

LI YANXIAN AND WEN BENHENG

- 1978 Guizhou Qianxi Guanyindong Jiushiqishidai wenhua de faxian jiqi yiyi, in *Gurenlei Lunwenji*: 77–90, ed. Chinese Academy of Sciences, Institute of Vertebrate Palaeontology and Palaeoanthropology. Beijing: Kexue Chubanshe.  
1986 *Guanyindong*. Beijing: Wenwu Chubanshe.

LI YANXIAN AND YOU YUZHU

- 1975 Guangxi Bose faxian de Jiushiqi. *Gu Jizhuidongwu yu Gu Renlei* 13(3):225–228.

LI YOUHENG

- 1961 Yunnan Lijiang Pendi yige Disiji purulei huashi didian. *Gu Jizhuidongwu yu Gu Renlei* 5:143–149.

LIAN ZHAOMEI

- 1981 Tainanxian Cailiaoxi de renlei huashi. *Guoli Taiwan Daxue Kaogu Renleixue Kan* 42:53–74.

LIN YIPU, PAN YUERONG, AND LU QINGWU

- 1978 Yunnan Yuanmou zao Gengxinshi purudongwu qun, in *Gurenlei Lunwenji*: 101–120, ed. Chinese Academy of Sciences, Institute of Vertebrate Palaeontology and Palaeoanthropology. Beijing: Kexue Chubanshe.

LIN YIPU AND ZHANG SENSUI

- 1978 Yunnan Lijiang Mujiqiao faxian de purulei huashi he Jiushiqi. *Diceng Gushengwu Lunwenji* 7:80–85.

LIU DONGSHENG AND DING MENGLIN

- 1983 Guanyu Yuanmou Ren huashi dizhi shidai de taolun. *Renleixue Xuebao* 2(1):40–48.  
1984a The characteristics and evolution of the palaeoenvironment of China since the late Tertiary, in *The Evolution of the East Asian Environment*: 11–40, ed. R. O. Whyte. Hong Kong: Centre of Asian Studies, University of Hong Kong.  
1984b Zhongguo zaoqi renlei huashi cengwei yu huangtu—shenhai chenji guqihou xuanhui de duibi. *Renleixue Xuebao* 3(2):93–101.

MOVIUS, H. L.

- 1944 *Early Man and Pleistocene Stratigraphy in Southern and Eastern Asia*. Papers of the Peabody Museum of American Archaeology and Ethnology, Harvard University. 19(3).

- 1949 Lower Palaeolithic archaeology in southern Asia and the Far East. *Studies in Physical Anthropology 1, Early Man in the Far East*: 17–82. Philadelphia: Wistar Institute Press.
- OLSEN, J. W.  
1987 The practice of archaeology in China today. *Antiquity* 61(232):282–290.
- OZAKI, H., W. H. SUNG, AND H. BABA  
1978 On human bones discovered at Zuozhen, Taiwan. *Jinruigaku Zasshi* 86(2):146.
- PEI WENZHONG (PEI WEN-CHUNG)  
1952 Sichuan Ziyang Huangshanxi renlei ji qita purudongwu huashi fajue jianbao. *Kexue Tongbao* 3(10):709–713.
- PEI WENZHONG (PEI WEN-CHUNG) AND WU RUKANG (WU JU-K'ANG)  
1957 Tze yang Paleolithic Man. *Institute of Vertebrate Paleontology, Academia Sinica, Memoir No. 1*. Beijing: Science Press (In Chinese and English).
- POPE, G. G.  
1988 Current issues in Far Eastern palaeoanthropology, in *The Palaeoenvironment of East Asia from the Mid-Tertiary*, Vol. 2: 1097–1123, ed. P. Whyte, J. S. Aigner, N. G. Jablonski, G. Taylor, D. Walker, P. X. Wang, and C. K. So. Hong Kong: Centre of Asian Studies, University of Hong Kong.  
1989 Bamboo and human evolution. *Natural History* 10:49–57.
- QIAN FANG, MA XINGHUA, LING XIAOHUI, JIANG FUCHU, XU SHUJIN, TIAN GUOQIANG, AND ZHOU JIE  
1989 Yunnan Yuanmou Zhupeng, Xiaohecun diqu ren yuan chao ke huashi shidai de chubu yanjiu. Paper presented at the International Symposium on Palaeoanthropology in Commemoration of the 60th Anniversary of the Discovery of the First Skull of Peking Man, Beijing, October (In Chinese).
- QIU ZHONGLANG  
1955 Han fuliang fenxi zai Zhongguo jizhong renlei huashi shang shiyong de chubu baogao. *Gushengwu Xuebao* 3(4):323–329.  
1985 The Middle Palaeolithic of China, in *Palaeoanthropology and Palaeolithic Archaeology in the People's Republic of China*: 187–210, ed. Wu Rukang and J. W. Olsen. Orlando: Academic Press.
- SHIKAMA, T., C. C. LIN, N. SHIMODA, AND H. BABA  
1976 Discovery of fossil *Homo sapiens* from Cho-chen in Taiwan. *Journal of the Anthropological Society of Nippon* 84(2).
- SICHUANSHEG WENWU GUANLI WEIYUANHUI  
1983 Sichuan Ziyang deng xian Shiqishidai wenhua. *Kaogu* 6:481–483.
- TEILHARD DE CHARDIN, PIERRE  
1938 Le Villafranchien d'Asie et la question des Villafranchien. *Compte-rendu Sommaire des Seances de la Societe Geologique de la France* 17:325–328.
- WALKER, D., AND SUN XIANGJUN  
1988 Vegetational and climatic changes at the Pleistocene—Holocene transition across the eastern tropics, in *The Palaeoenvironment of East Asia from the Mid-Tertiary*: 579–591, ed. P. Whyte, J. S. Aigner, N. G. Jablonski, G. Taylor, D. Walker, P. X. Wang, and C. K. So. Hong Kong: Centre of Asian Studies, University of Hong Kong.
- WANG LINGHONG  
1989 Zhongguo yuangu renlei niandaixue de xin jinzhan, in *Zhongguo Yuangu Renlei*: 392–404, ed. Wu Rukang, Wu Xinshi, and Zhang Senshui. Beijing: Kexue Chubanshe.
- WANG LINGHONG, PENG SHULIN, AND CHEN YUANZHANG  
1982 Guilin Baojiyan faxian de gurenlei huashi he shiqi. *Renleixue Xuebao* 1(1):30–35.
- WANG PINXIAN  
1988 Late Cenozoic palaeoclimatology in China: Progress and problems, in *The Palaeoenvironment of East Asia from the Mid-Tertiary*: 377–392, ed. P. Whyte, J. S. Aigner, N. G. Jablonski, G. Taylor, D. Walker, P. X. Wang, and C. K. So. Hong Kong: Centre of Asian Studies, University of Hong Kong.
- WANG XIANZHENG  
1984 The palaeoenvironment of China from the Tertiary, in *The Evolution of the East Asian Environment*: 472–482, ed. R. O. Whyte. Hong Kong: Centre of Asian Studies, University of Hong Kong.

## WATANABE, H.

- 1985 The Chopper-Chopping Tool Complex of eastern Asia: An ethnoarchaeological—ecological reexamination. *Journal of Anthropological Archaeology* 4:1–18.

## WEI QI, HUANG WEIWEN, AND ZHANG XINGYONG

- 1984 Lijiang Mujiqiao xin faxian de Jiushiqi. *Renleixue Xuebao* 3(3):225–233.

## WEIDENREICH, F.

- 1943 The skull of *Sinanthropus pekinensis*: A comparative study on a primitive hominid skull. *Palaeontologia Sinica*, New Series D 10:1–485.

## WEN BENHENG

- 1984 Yunnan Yuanmou Pendi faxian de Jiushiqi, in *Yuanmou Ren*: 105–112, ed. Zhou Guoxing and Zhang Xingyong. Kunming: Yunnan Renmin Chubanshe.

## WHYTE, P., J. S. AIGNER, N. G. JABLONSKI, G. TAYLOR, D. WALKER, P. X. WANG, AND C. K. SO, EDs.

- 1988 *The Palaeoenvironment of East Asia from the Mid-Tertiary*. 2 volumes. Hong Kong: Centre of Asian Studies, University of Hong Kong.

## WHYTE, R. D., ED.

- 1984 *The Evolution of the East Asian Environment*. 2 volumes. Hong Kong: Centre of Asian Studies, University of Hong Kong.

## WOLPOFF, M.

- 1989 East Asian fossils and the origin of races, in *Proceedings of the Circum-Pacific Prehistory Conference 1, Human Evolution in the Circum-Pacific Region*: 143–162, compiled by G. Krantz, C. K. Ho, and M. Stoneking. Seattle: Circum-Pacific Prehistory Conference.

## WOLPOFF, M., WU XINZHI, AND A. G. THORNE

- 1984 Modern *Homo sapiens* origins: A general theory of hominid evolution involving the fossil evidence of East Asia, in *The Origin of Modern Humans*: 411–483, ed. F. H. Smith and F. Spencer. New York: Alan R. Liss.

## WU MAOLIN

- 1983 1981-nian faxian de Anhui Hexian yuanren huashi. *Renleixue Xuebao* 2(2):109–115.  
 1984 Guizhou Tongzi xin faxian de renlei huashi. *Renleixue Xuebao* 3(3):195–201.  
 1989 Zhongguo de wanqi zhiren, in *Zhongguo Yuangu Renlei*: 42–61, ed. Wu Rukang, Wu Xinzhi, and Zhang Senshui. Beijing: Kexue Chubanshe.

## WU RUKANG

- 1959 Guangxi Liujiang faxian de renlei huashi. *Gu Jizhuidongwu yu Gu Renlei* 1(3):97–104.  
 1985 New Chinese *Homo erectus* and recent work at Zhoukoudian, in *Ancestors: the Hard Evidence*: 245–248, ed. E. Delson. New York: Alan R. Liss.

## WU RUKANG AND DONG XINGREN

- 1982 Anhui Hexian Ren huashi de chubu yanjiu. *Renleixue Xuebao* 1(1):2–13.  
 1985 *Homo erectus* in China, in *Palaeoanthropology and Palaeolithic Archaeology in the People's Republic of China*: 79–89, ed. Wu Rukang and J. W. Olsen. Orlando: Academic Press.

## WU RUKANG AND LIN SHENGLONG

- 1985 Chinese palaeoanthropology: Retrospect and prospect, in *Palaeoanthropology and Palaeolithic Archaeology in the People's Republic of China*: 1–27, ed. Wu Rukang and J. W. Olsen. Orlando: Academic Press.

## WU RUKANG AND J. W. OLSEN, EDs.

- 1985 *Palaeoanthropology and Palaeolithic Archaeology in the People's Republic of China*. Orlando: Academic Press.

## WU RUKANG AND PENG RUCE

- 1959 Guangdong Shaoguan Maba faxian de gurenleixing renlei huashi. *Gu Jizhuidongwu yu Gu Renlei* 1(4):159–164.

## WU RUKANG, WU XINZHI, AND ZHANG SENSUI, EDs.

- 1989 *Zhongguo Yuangu Renlei*. Beijing: Kexue Chubanshe.

## WU XINZHI

- 1989a Yunnan Yuanmou jinnian faxian de guyuan huashi, in *Zhongguo Yuangu Renlei*: 266–267, ed. Wu Rukang, Wu Xinzhi, and Zhang Senshui. Beijing: Kexue Chubanshe.  
 1989b Zhongguo de zaoqi zhiren, in *Zhongguo Yuangu Renlei*: 24–41, ed. Wu Rukang, Wu Xinzhi, and Zhang Senshui. Beijing: Kexue Chubanshe.

## WU XINZHI AND WANG LINGHONG

- 1985 Chronology in Chinese palaeoanthropology, in *Palaeoanthropology and Palaeolithic Archaeology in the People's Republic of China*: 29–51, ed. Wu Rukang and J. W. Olsen. Orlando: Academic Press.

## WU XINZHI AND WU MAOLIN

- 1985 Early *Homo sapiens* in China, in *Palaeoanthropology and Palaeolithic Archaeology in the People's Republic of China*: 91–106, ed. Wu Rukang and J. W. Olsen. Orlando: Academic Press.

## WU XINZHI AND ZHANG YINYUN

- 1978 Zhongguo gurenleixue zonghe yanjiu, in *Gurenlei lunwenji*: 28–42, ed. Institute of Vertebrate Palaeontology and Palaeoanthropology, Chinese Academy of Sciences. Beijing: Kexue Chubanshe.

## WU XINZHI AND ZHANG ZHENBIAO

- 1985 *Homo sapiens* remains from late Palaeolithic and Neolithic China, in *Palaeoanthropology and Palaeolithic Archaeology in the People's Republic of China*: 107–133, ed. Wu Rukang and J. W. Olsen. Orlando: Academic Press.

## WU XINZHI, ZHANG ZHENBIAO, AND ZHANG JIANJUN

- 1984 Liujiang huashi zhiren de shengao. *Renleixue Xuebao* 3(3):210–211.

## XIE YANPING AND YOU XUEHUA, EDS.

- 1984 *Zhongguo jiushiqishidai Wenhua Yizhi*. Hong Kong: Chinese University of Hong Kong Press.

## XU QINQI AND YOU YUZHU

- 1984 Hexian dongwuqun yu shenhai chenjiwu de duibi. *Renleixue Xuebao* 3(1):62–67.

## XU REN

- 1984 Changes of vegetation in China since the late Tertiary, in *The Evolution of the East Asian Environment*: 426–432, ed. R. O. Whyte. Hong Kong: Centre of Asian Studies, University of Hong Kong.

## XUE XIANGXU

- 1991 The characters of paleoclimate and paleoenvironment of the Quaternary in China in the light of mammalian fossils. Paper presented to the Thirteenth International Union for Quaternary Research, Beijing, China.

## YANG LIN

- 1961 Sichuan Hanyuanxian Fulinzen Jiushiqishidai wenhua yizhi. *Gu Jizhuidongwu yu Gu Renlei* 4(4):353–359.

## YOU YUZHU, PRINCIPAL ED.

- 1991 *Zhangzhou Shiqian Wenhua*. Fuzhou: Fujian Renmin Chubanshe.

## YUNNANSHENG BOWUGUAN

- 1977 Yunnan Lijiang renlei tougu de chubu yanjiu. *Gu Jizhuidongwu yu Gu Renlei* 15:157–161.

## ZHANG SENSUI

- 1983 Woguo nanfang Jiushiqishidai wanqi wenhua de ruogan wenti. *Renleixue Xuebao* 2(3):218–230.  
1985 The Early Palaeolithic of China, in *Palaeoanthropology and Palaeolithic Archaeology in the People's Republic of China*: 147–186, ed. Wu Rukang and J. W. Olsen. Orlando: Academic Press.

## ZHANG SENSUI AND CAO ZETIAN

- 1980 Guizhou Jiushiqi wenhua gailun. *Guiyang Shiyuan Xuebao (Shehui Kexue Ban)* 2:1–11.

## ZHANG SENSUI, WU YUSHU, YU QIANLI, LI XUANMIN, AND YANG XINGLONG

- 1982 Tongliang Jiushiqi yizhi ziran huanjing de cailun. *Gu Jizhuidongwu yu Gu Renlei* 20(2):165–179.

## ZHANG XINGYONG, ZHENG LIANG, AND GAO FENG

- 1989 Paleanthropological significance of new genus *Sinopithecus* from southwest China, in *Proceedings of the Circum-Pacific Prehistory Conference 1, Human Evolution in the Pacific Region*: np, compiled by G. Krantz, C. K. Ho, and M. Stoneking. Seattle: Circum-Pacific Prehistory Conference.

## ZHAO SONGQIAO

- 1986 *Physical Geography of China*. Beijing: Science Press.  
1988 A preliminary study on the evolution of the physical regionalization of China since the early Tertiary, in *The Palaeoenvironment of East Asia from the Mid-Tertiary*: 393–400, ed. P. Whyte,

J. S. Aigner, N. G. Jablonski, G. Taylor, D. Walker, P. X. Wang, and C. K. So. Hong Kong: Centre of Asian Studies, University of Hong Kong.

ZHOU GUOXING

- 1988 The first man in China: The date and environment of Yuanmou Man, in *The Palaeoenvironment of East Asia from the Mid-Tertiary*, Vol. 2:1062–1068, ed. P. Whyte, J.S. Aigner, N. G. Jablonski, G. Taylor, D. Walker, P. X. Wang, and C. K. So. Hong Kong: Centre of Asian Studies, University of Hong Kong.

ZHOU GUOXING AND HU CHENGZHI

- 1979 Yuanmou Ren yachi huashi de zaiyanjiu. *Gu Jizhuidongwu yu Gu Renlei* 17(2):149–162.

ZHOU GUOXING AND ZHANG XINGYONG, EDS.

- 1984 *Yuanmou Ren*. Kunming: Yunnan Renmin Chubanshe.

ZHU XIANMO

- 1988 Red clay and red residuum in South China, in *The Palaeoenvironment of East Asia from the Mid-Tertiary*: 102–110, ed. P. Whyte, J. S. Aigner, N. G. Jablonski, G. Taylor, D. Walker, P. X. Wang, and C. K. So. Hong Kong: Centre of Asian Studies, University of Hong Kong.

ABSTRACT

Palaeolithic sites discovered in southern China in the last 20 years document the human occupation of this region through the Pleistocene. Tool inventories from localities south of 33°N latitude and east of the eastern margin of the Tibetan Plateau have greatly expanded the range of variability in the Palaeolithic of this region. Bone artifacts and stone spheroids, once thought to be confined to northern Chinese Palaeolithic industries, have been recovered from South China sites as well. We see not only the persistence of the chopper/chopping tool tradition from the earliest Palaeolithic assemblages through to terminal Pleistocene sites but also the presence of assemblages dominated by smaller flaked implements, emphasizing the problems involved in equating hominid type and technology. Natural site formation processes affecting assemblage composition are a priority for future archaeological investigations. KEYWORDS: South China, Pleistocene, Palaeolithic, hominid, geoarchaeology.